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COMMITTEE ON HIGHER EDUCATION

Evidence submitted by the Council

This statement of evidence was submitted to the Committee on Higher Education, under the chairmanship of Lord Robbins, on 28 July. It was explained that the statement had the general approval of the Council as a body, though individual Members of Council might hold somewhat divergent views on matters of detail. On 27 September the President and the Secretary attended a meeting of the Robbins Committee and answered a number of questions

As the Council of the qualifying professional organization for chemists, we welcome this opportunity of submitting observations on various matters relevant to the field of inquiry of the Committee on Higher Education. We note with particular satisfaction that the terms of reference of the Committee relate not only to universities but also to other types of institutions (whether in England and Wales or in Scotland), for we believe that a closer correlation of the policies of the separate authorities concerned is essential to the proper development of higher education in science and technology in Great Britain.

I. THE BASIS OF OUR INTEREST

Our interest in this inquiry stems largely from the fact that the Institute has for over 75 years conducted its own examinations for admission to professional membership. These examinations, which are at honours degree level in chemistry, are now for admission to graduate membership (Grad. R.I.C.). The Institute is also concerned with assessing the standards of other qualifications, such as degrees and diplomas, on which complete or partial exemption from those examinations may be accorded. This concern extends back to standards of general and scientific education in schools, in relation to such awards as the General Certificate of Education at Ordinary and Advanced levels, and applies specifically to Ordinary and Higher National Certificates and Higher National Diplomas in Chemistry and in Applied Chemistry, which are administered jointly by the Institute and the Ministry of Education (England and Wales) and the Scottish Education Department.

The Institute is also directly concerned with assessing the quality of postgraduate experience, gained in various fields of work involving the practice, application or teaching of chemistry, for admission to its corporate membership: first as an Associate (A.R.I.C.) and later, subject to attainment of professional maturity and responsibility, as a Fellow (F.R.I.C.). In such assessments account may be taken of the award of higher degrees of universities and higher diplomas, including the Institute's postgraduate Diplomas in Applied Chemistry and its recently established Research Diploma.

Moreover, the Institute has a special interest in the conditions of service and remuneration of professionally qualified chemists in various occupational categories, and keeps itself informed as to the needs of employing bodies for chemists with diverse types of training, qualification and experience.

II. QUALIFICATIONS IN CHEMISTRY AND APPLIED CHEMISTRY AT FIRST-DEGREE LEVEL

In the field of chemistry there are several types of award of full graduate standard and diverse routes through which they may be obtained. The most important of these are referred to here in general terms.

(*a*) *University degrees.*—All the universities in Great Britain provide courses leading to honours degrees in chemistry (and several now do so in biochemistry). Most of these are of the 'special' honours type, with chemistry as the main subject but with physics and mathematics among the necessary ancillary subjects. Several also provide 'general' honours courses in which chemistry is one of two main subjects. (London University degrees of both types may also be taken 'externally' in technical colleges, but most of the courses, especially for part-time students, are now of the general honours type.) A few universities offer degrees on which honours may be obtained in chemical technology or certain fields of applied chemistry. In some universities there are courses leading to other kinds of 'ordinary' or 'general' degrees in which chemistry is a principal subject, and there may be provision for students taking these to be selected to transfer, or to go on, to a special honours course.

(*b*) *Diplomas in Technology.*—Most colleges of advanced technology and several other technical colleges now provide full-time or sandwich courses of honours degree standard for the Dip. Tech. in Applied Chemistry (some being so described, but others as Chemical Technology or Industrial Chemistry).

(*c*) *Graduate Membership of the R.I.C.*—Some 70 technical colleges (including all the colleges of advanced technology) have been specifically recognized by the Institute for the training of candidates to the level of its final (Part II) examination for Grad. R.I.C. which is at honours degree level. Five of these colleges are in 'special relationship' with the Institute; they conduct their own final examinations subject to external assessment by the Institute. The courses for Grad. R.I.C.

may be on a full-time or sandwich basis (when the H.N.D. in Chemistry may be taken *en route*) or on a part-time basis, usually with day release. Many part-time students proceed by way of National Certificates in Chemistry, but they are being increasingly encouraged and enabled to transfer to full-time or sandwich courses for the later stages, especially after passing Part I of the Grad. R.I.C. examination or gaining exemption from it on the basis of a good H.N.C. in Chemistry. Examination results have shown the great value to students of having had a substantial period on a full-time or sandwich course.

Exemption from the whole of the Grad. R.I.C. examination is afforded by good honours degrees in chemistry (or, under certain conditions, in biochemistry or applied chemistry) of universities in Great Britain and Ireland, or by first or second class honours in the Diploma in Technology (based on a course with an adequate content of general chemistry) or in any of the college diplomas, A.R.C.S.T., A.H.-W.C. and D.L.C. Most other degrees or diplomas afford only partial exemption, *e.g.* from Part I of the Grad. R.I.C. examination.

Under revised By-laws that have just been approved (subject to allowance by the Privy Council) it is proposed to establish a new grade of corporate membership of the Institute, to be known as Licentiateship (L.R.I.C.), for admission to which the requirement will be the equivalent of a good 'pass' degree coupled with a period of approved experience in the practice, application or teaching of chemistry. This will provide for the intake to corporate membership of many holders of degrees or diplomas at a lower academic level than admit to Graduate Membership or Associateship, including (subject to compliance with appropriate conditions, covering the Institute's normal requirements as to general education, and physics and mathematics as ancillary subjects) holders of the H.N.D. in Chemistry and those who obtain the H.N.C. in Chemistry and extend their studies of chemistry and relevant technology for at least a further year.

The intention is that L.R.I.C. shall be a grade for professional scientists and technologists (as distinct from technicians) and it is hoped that its establishment will encourage many more to attain this status. Those who obtain Ordinary or Higher National Certificates or the H.N.D. in Chemistry or in Applied Chemistry but do not qualify for L.R.I.C. will provide a much-needed supply of chemical technicians and assistants of various kinds (*see* section IV), but some of these may go forward to take the membership qualifications of such technological professional bodies as the Society of Dyers and Colourists or the Plastics Institute.

III. POSTGRADUATE QUALIFICATIONS IN CHEMISTRY AND APPLIED CHEMISTRY

Higher degrees of universities in the U.K. are awarded for research and/or advanced study carried out within the university. For research most universities accept only those who have obtained good honours in their first degrees (or latterly in the Dip. Tech.) but many will also accept those with other equivalent qualifications, including Grad. R.I.C. Only holders of suitable first degrees of London University may be registered to work for higher degrees of that University externally in technical colleges or other approved establishments. Registration for the Institute's Research Diploma (at Ph.D. level) is open to Graduate Members, Associates or Fellows of the Institute who undertake research work (part-time or full-time) in pure or applied chemistry in a technical college or an industrial or government establishment under an approved supervisor. On the applied side there is also the M.C.T. (Membership of the College of Technologists) awarded for research undertaken, mainly in colleges of advanced technology, in close association with industry.

IV. THE NEED FOR QUALIFIED CHEMISTS OF VARIOUS KINDS

Diverse routes to a variety of qualifications of graduate standing in chemistry or applied chemistry are thus already available in several types of institutions. We believe that such diversity should be retained. Although we would not advocate the establishment of new types of institutions of higher education, we believe that there should be scope for the extension of existing types and freedom for them to experiment with and develop various kinds of courses and awards to meet the growing demand for qualified chemists and chemical technicians for diverse purposes.

Qualified chemists are needed not only for teaching at all levels—in schools, technical colleges and universities—and for research in institutions of higher education and in research institutes, but also in very large numbers for research, development and control of materials and processes in practically all fields of industry (including the nationalized industries) and in many government establishments (including those of the U.K.A.E.A.). The fact that chemistry is a basic science, occupying a central position among the branches of science and technology, means that chemists are required in a wide range of activities, extending on the one hand through biochemistry to biological, medical and agricultural science and to food technology, and on the other through physical chemistry and physics to chemical engineering, metallurgy, and the technology of fuels, plastics, textiles, etc. Indeed, many who graduated in chemistry have become technologists of various kinds. Many have become heads of educational and government establishments or directors and managers of industrial concerns.

In all these fields there is a demand—and indeed much competition—for chemists with the highest academic qualifications, but plenty of scope for those whose somewhat lower academic attainments are made up for by other desirable qualities. Thus, industry

and the government service need more with good honours degrees or equivalent qualifications, especially for research—which may range from the fundamental to the specifically technological, but always involves a wide knowledge and understanding of scientific principles and ability to apply them to diverse problems and developments. Some of these organizations demand applicants with a Ph.D. degree for such posts, but others are not convinced as to the value of what may be a somewhat narrow and academic introduction to research and prefer to take on those with good first degrees; many would welcome more applicants with research experience covering a wide range of investigation and techniques as potential leaders of applied research and what may be described as pioneering technology. Parity of esteem with leaders of 'pure' research is needed to attract more of the best brains to these less academic fields of research on which the initiation of new industrial developments depends.

Moreover, there will certainly be a growing demand for people whose first degrees or equivalent qualifications have been of a more general kind than the well-established 'special honours' degree in chemistry. This requirement is being partly met by the provision of general honours degrees in two main science subjects in several universities (degrees that should be especially useful for school teachers as well as for scientists engaged in other types of work), and of honours degrees and Diplomas in Technology in various fields of applied chemistry. Extension of provisions for the Dip. Tech., especially in colleges of advanced technology, would seem to be specially desirable, and it is expected that introduction of the L.R.I.C. (*see* section II) will have an important effect in meeting some of these needs, especially by encouraging the provision of post-H.N.C. courses in such fields as modern analytical methods, radiochemistry, and the chemical technology of particular classes of materials and processes.

For those who are to be employed in industry or comparable fields of government service, a period of industrial experience before or during their college training has advantages. Many full-time students in universities and technical colleges obtain some such experience through relevant vacation work, but the sandwich type of course provides this much more assuredly and has been widely welcomed since its introduction in the field of chemistry a few years ago. There is, however, scope for considerable expansion, especially perhaps for college-based students (as opposed to those who are employees of a particular firm and are released as such to a sandwich course), provided that adequate grants for the college period of training can be made available. More attention needs to be given to the nature of the training to be offered during the industrial periods of a sandwich course. The National Council for Technological Awards has been concerned with this problem (for Dip. Tech. courses), but little has yet been done for sandwich courses leading to other awards.

V. THE NEED FOR VARIOUS KINDS OF TECHNICIANS

In all fields in which qualified chemists are employed there is an increasing need for assistants and technicians of various kinds—perhaps four to five for every professionally qualified scientist or technologist in many kinds of occupation. Indeed, one of the great changes that has taken place since 1939 is the recognition of the vital need to produce large numbers of well-trained technicians as assistants in research laboratories and to relieve graduate chemists of the more routine work in analytical control laboratories.

This need is being increasingly met by the expansion of National Certificate courses in Chemistry and the growing tendency of students to qualify for endorsements in subjects relevant to the type of employment. With the advent of complex industrial processes with automatic control there is a demand for foremen and undermanagers with much higher technical training than in the past. These may come from National Certificate courses in Engineering or from those in Chemistry or Applied Chemistry or from possible alternative chemical technician courses in which some of the more erudite theoretical chemistry is replaced by appropriate engineering or electronics. In any event, much depends on the effectiveness of 'training on the job' that is given to these part-time students. It has been suggested that the supply of chemical assistants and technicians in general could be greatly expanded if it were possible for every senior chemist engaged in laboratory work in a university or technical college to take on a suitable boy or girl from a secondary modern school for three to four years of training; some of these could then be made available to industry.

In teaching institutions at all levels there is a great need for an adequate supply of good technicians, including those of the laboratory steward type. Shortages of these in many schools impose a serious burden on science teachers and make it more difficult to recruit such teachers of appropriate calibre. For the training of these technicians the part-time courses in 'Laboratory Technicians' Work' offered by the City and Guilds of London Institute in conjunction with the Institute of Science Technology are of particular value and could be extended with advantage. Here again, training on the job is of special importance.

VI. INSTITUTIONS OF HIGHER EDUCATION CO-ORDINATION OF DEVELOPMENT

Universities.—We welcome the great expansion that has occurred and is still continuing in the provisions for degree courses of various kinds in universities, and the agreement to establish several new universities.

Colleges of Advanced Technology.—We are particularly interested in this development for, in 1950, we advocated

the upgrading of a limited number (6–10) of technical colleges to this level. At that time we were in favour of encouraging them to develop their own diplomas of Associateship as separate awards, each of which would have to earn its own esteem (as had long since happened with such diplomas as A.R.C.S., A.R.S.M., A.C.G.I., A.R.T.C. (now A.R.C.S.T., Glasgow), A.H.-W.C., etc.) which still have a recognized status even where the college has become part of or affiliated to a university and students may obtain a degree as well as the college diploma. We now accept the establishment of the National Council for Technological Awards for bestowing a common award (Dip. Tech.) at honours degree level on approved courses in colleges of advanced technology and other technical colleges. There is, however, much to be said for Cs.A.T. being allowed to award degrees, although it would still be desirable for these to be distinguishable from those of universities, *e.g.* the Dip. Tech. might be converted to 'B. Tech.', and the research diploma, M.C.T., possibly to 'D. Tech.', if obtained in these colleges (*cf.* B.Sc. Tech. etc., obtainable in the Manchester College of Science and Technology, which represents the Faculty of Technology in the University of Manchester).

In the meantime, we welcome the recent proposal to free Cs.A.T. from local authority control, and should like to see them enjoy the academic freedom accorded to universities, with their income provided on the basis of quinquennial reviews by a body comparable with the University Grants Committee. It is admitted, however, that in so far as Cs.A.T. acquire the status of university institutions there will be a case for affiliating them in some way with universities. But most universities in the U.K. already offer first-degree courses in many technological fields, such as the main branches of engineering and metallurgy, and some do so in special fields of technology or applied science including some branches of applied chemistry (*e.g.* Leeds). This raises the question of how far it is necessary or desirable to retain or introduce separate courses of comparable character leading to different awards in universities and in Cs.A.T. Much will depend on how far there are differences of approach and of general atmosphere in the two kinds of institution. It is to be expected that the universities will keep a more academic approach even to technological subjects and that Cs.A.T. will be more in touch with the industrial side, especially in so far as they are concerned with sandwich courses. But both require active science departments and staff and equipment of the highest calibre. It is assumed that, in any event, the number of Cs.A.T. will not be allowed to increase unduly.

Other Technical Colleges.—Many of these have long-established reputations for the training of candidates to honours degree level in chemistry for Grad. R.I.C. (formerly directly for A.R.I.C.) or External London degrees (now mostly by the General Honours course), and several have recently established courses for the Dip. Tech. in fields of applied chemistry. It is desirable that most of them should be encouraged to serve regional and local needs, especially for part-time courses. With the further development of full-time and sandwich courses, however, it may become possible to concentrate the most advanced work in chemistry in fewer colleges. At present there are many large new colleges with excellent facilities but very few students in the advanced classes. It would certainly be more economic to equip and staff fewer colleges for top-level work, including the full-time course for the final stage of Grad. R.I.C., which it is desired to encourage further. This is dependent on suitable hostel accommodation being available.

Teaching and Research.—It is regarded as of special importance that all who are engaged as teachers at the higher levels should have full opportunity and facilities for research. In universities and in Cs.A.T. this is fully recognized and is generally effective. In many technical colleges, however, research is not being adequately prosecuted. Money is not always available and the allowance of time from teaching duties is often insufficient. Moreover, there has been a lack of a suitable higher qualification for a teacher who does not already possess a first degree of London University; the introduction of the R.I.C. Research Diploma and, in some instances, the M.C.T. award may help to remove this difficulty.

The provision of good research facilities is one of the major attractions of teaching posts in universities, and the question has been raised as to whether the emphasis on published research in making academic appointments ensures that the universities get a sufficient number of able and inspired lecturers. By no means all the most gifted research workers make good teachers, and it is important that a proper balance be struck between those whose primary interest is in extending the frontiers of knowledge and those who, while actively engaged in research, have a capacity for putting over to students the significance and implications of scientific advances. It might be helpful if more scope for advancement could be given to those who prove to be exceptionally good teachers.

General.—We believe it to be of the highest importance that there should be much greater opportunities for exchanges of ideas between universities, colleges of advanced technology and other technical colleges on their future developments so as to avoid unnecessary conflicts of purpose and wastage of effort. This is particularly significant in fields of science and technology where great expenditure on laboratories, workshops and specialized equipment is involved, and it is no doubt a matter to which the Committee will give special attention.

VII. TEACHERS IN SCHOOLS

It is generally agreed that the proper development of higher education in science and technology is dependent on finding means for overcoming the present shortage of good teachers of science and mathematics in grammar schools as well as in secondary modern schools. This shortage is particularly desperate in girls' schools and is a major factor in limiting the supply of women scientists and technicians.

It has been indicated to us that the prospect of using the recent extension to three years of courses for non-graduate teachers in Teacher Training Colleges for alleviating the shortage of science teachers has been dimmed by the declared intention of concentrating efforts initially on producing primary school teachers. Secondary modern schools will be hardest hit by this policy which, if maintained, may lead to the virtual cessation of serious science teaching in many of them.

For graduate teachers the practice of spending a year after graduation in the education department of the university is reported to be reasonably satisfactory. But for those who enter a university with the firm intention of teaching, consideration should be given to extending the experiment at Keele of integrating teacher training with the degree course.

It has been suggested to us that a degree (B.Ed.) should be awarded on successful completion of an appropriate three-year course at a Teacher Training College. This would seem to be worthy of consideration.

VIII. CO-ORDINATION WITHIN THE WHOLE EDUCATIONAL SYSTEM

Whatever may be the future pattern of higher education, a continuing need will be to provide effective machinery to ensure that young people are enabled to proceed from school to the type of further education that is suited to them, and from which they will derive the greatest benefit. We also attach special importance to provisions for transfers between various kinds of courses in institutions of higher education, where this is desirable to correct initial errors of selection or to allow for the diverse ways in which students develop.

It cannot be assumed that everyone who obtains two or more passes at 'A' level in the G.C.E. would succeed in getting a good honours degree if he went to a university. Nor should it be assumed that those who do indifferently well in the 'special' honours type of course provided by most universities would not have benefited more by taking a more general type of course, such as that leading to a general honours degree, which may be of equivalent overall standard but involve rather less capacity for understanding abstract theories and their mathematical implications. There is little doubt that many with a less academic turn of mind would have profited more by taking full-time or sandwich courses leading to awards of honours degree standing in technical colleges, especially in colleges of advanced technology, for the Dip. Tech. in Applied Chemistry or for the Grad. R.I.C. in Chemistry. Others might be better advised to proceed straight from school to employment, and to take part-time courses for the H.N.C. in Chemistry, which may be either an end in itself or may lead through further courses to L.R.I.C. or, by way of Grad. R.I.C., to A.R.I.C. An increasing number of school-leavers with appropriate 'A' level passes are following this route, at least as far as the H.N.C. Those who are able to go further are encouraged to transfer to a full-time or sandwich course for the later stages. Moreover, opportunities already exist for transfer at the O.N.C. stage to Dip. Tech. or external London general honours degree courses in technical colleges, or even to go to universities.

The first requirement is that there should be full information about the various routes to qualification available to the schools and to pupils and their parents, so that boys and girls who are interested in going on with chemistry may take such appropriate subjects in the G.C.E. or the Scottish Certificate of Education as will enable them to qualify for entry to universities or technical colleges, and to fulfil the preliminary requirements of the professional body. The university route to a qualification is well known and 'popular'. Applicants for places in the chemistry departments of universities are in excess of the number of places available, but there are many courses of degree level in technical colleges that have barely enough students to justify their continuance. The alternative possibilities must be made more widely known.

We believe that much closer relations need to be established between schools and universities, to ensure that the content and pattern of VIth form courses may be developed on lines that will serve the best needs of those going on to universities. At present the VIth form courses in grammar schools are largely influenced by the requirements of the universities for G.C.E. 'A' level subjects, through examinations set by the various Examining Boards. Recently the Science Masters' Association and the Association of Women Science Teachers have put forward proposals for a drastic change, not only in the content of, but also in the approach to, science teaching in schools, and are feeling the lack of effective machinery for getting revised syllabuses discussed with teachers in the universities, so that these may be introduced into the examination system under agreed conditions. This type of problem is likely to arise from time to time, and we believe it to be of great importance that something should be done to provide for regular interchanges of views between teachers in schools and those in universities and other institutions of higher education (which both parties would probably welcome), so that the whole system may be integrated and kept in line with modern requirements. Much is being done in this direction in other countries for science teaching, and there is no shortage of ideas

in this country: the difficulty lies in passing them across the barrier between the schools and the universities.

Selection Procedure.—It is highly desirable that university selection procedure should be improved, and that the system should be extended to cover entry into technical colleges, or at least into colleges of advanced technology, where some applicants might be more appropriately placed. It is appreciated that there are difficulties in organizing effective selection procedure on a wider basis. Even at present, where universities only are concerned, the problem of sorting out multiple applications is a serious one. Moreover, G.C.E. 'A' level results may not be available in time, and selection must be based on interviews and reports, or on the results of an extra (third) year spent in the VIth form. Holding 'A' level examinations earlier, with results available by the end of May, would be a good answer if the selection procedure could be deferred to early summer. This is a general problem that will become more pressing as greater numbers of good VIth form pupils seek entry to an increased number of universities and other institutions for higher education.

In so far as the selection procedure for entry to universities and technical colleges is based on passes in appropriate subjects at specified levels in the G.C.E. or the Scottish Certificate of Education, it is bound to be imperfect. Moreover, students themselves develop diverse aptitudes at different stages. We believe, therefore, that there should be more scope for students to transfer from one type of course to another, or even from one kind of institution to another, if this seems to be desirable at a particular point. Thus it might be desirable to re-assess the position of university students after the first year, and to decide then if they should proceed to a special honours course, or go forward to some more general type of degree course, or even be transferred to an appropriate course in a college of advanced technology, or other technical college. Our concern is that not only those who initially set their sights too low, but also those who set them too high or in the wrong direction, should be able to correct the position. Otherwise neither may be able to make the best of their abilities in their own interest or in that of the country as a whole.

UNIVERSITY GRANTS COMMITTEE REPORT

The annual report of the University Grants Committee, entitled *Returns from Universities and University Colleges, 1959–60* (Cmnd 1489: H.M.S.O., 4*s.* 6*d.* net), refers to the recommendation to establish new university institutions in Essex (Colchester), Kent (Canterbury) and Warwickshire (Coventry), together with one other, whose location is still to be announced, in addition to those already authorized in Sussex, East Anglia and York. The Committee expresses the view, however, that the question of the establishment of any more new universities, beyond the seven already referred to, must await the report of the Committee on Higher Education (the Robbins Committee), which was appointed by the Prime Minister in February.

During the year the U.G.C. has carried out a further estimate, at the request of the Advisory Council on Scientific Policy, of university resources, in terms of manpower and money devoted to research in pure and applied science, medicine, dentistry, agriculture, forestry and veterinary science. The total number of staff and research students employed in the departments covered was 16,882, of whom 53 per cent were in the pure sciences. Of these, 995 university staff and 2,018 research students were in chemistry departments, the university staff devoting an estimated 51 per cent of time to research work. There was an estimated total expenditure of £14·1 million attributed to research, excluding 'overheads' such as administration, libraries and maintenance of premises. The proportion of this attributed to chemistry departments was nearly £2 million.

Of the 8,534 technicians employed in the main groups of sciences and applied sciences in the survey, 1,175 were in chemistry departments. This gives a ratio of technicians to academic staff of about 1·2:1, and a proportion of technicians to academic staff and research students of 1:2·5 for chemistry. The overall ratios for all departments are 1:1 and 1:1·8 respectively. It should be remembered, however, that many technicians have duties connected with teaching as well as research.

The number of full-time students was 104,000, of whom 83,100 were studying for a first degree, including 20,000 who were reading pure science.

First degrees numbered 21,700, 27 per cent in pure science. Comparison of the *published figures* with those of previous years is shown in the following table:

	Figures as Published				
	1956	1957	1958	1959	*1960*
Chemistry	752	779	876	883	*926*
Biochemistry ..	87	87	92	141	*81*
Physics	542	588	695	804	*1,404*
Mathematics ..	391	427	429	473	*593*
Chemical Engineering	116	125	153	169	*209*

On further inquiry, however, we understand that *the figures for 1960 are incorrect*, and are now (8 November) being revised. It seems that the total of honours degrees in chemistry was about 1,000, and in physics rather less than 900.

CHEMICAL REACTION SEQUENCES IN BACTERIA

Some Recent Discoveries

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There is an observation of Sir Thomas Browne,[1] particularly pleasing to microbiologists, that runs as follows: 'ruder heads stand amazed at those prodigious pieces of nature, Whales, Elephants, Dromidaries, and Camels; these I confesse, are the Colossus and Majestick pieces of her hand; but in these narrow Engines there is more curious Mathematicks, and the civilitie of these little Citizens, more neatly set forth the wisedome of their Maker.'

Interest in the little citizens of nature does indeed increase the more we know about them. However, bacteria are not studied so intensively by biochemists simply because they have a unique fascination. It is true that they are the most plastic form of living matter in so far as they are chemically the most versatile, but the basic pattern of their chemistry is the same as that of most cells. There exists in all cells a complex network of reactions involving compounds that survive as individual molecules only for brief periods between synthesis and decomposition. In this network we can trace several reaction cycles, common to all forms of life and catalysed by similar enzymes requiring the same co-factors. Moreover, bacteria often synthesize these coenzymes, as well as compounds such as aromatic amino acids, which the higher organisms fail to make and hence require in their diet.

Nearly everything we know about the reactions by which living things synthesize the benzene nucleus was obtained from studies with bacteria. There are certain problems whose solution is quite basic for a full chemical description of life and which we see for the first time to be not utterly insoluble, for example the elucidation of the complete structures of enzymes and hence of their mode of action, or the mechanism of protein biosynthesis and its relation to genetics. These are problems connected not only with the whale, the camel or man; they relate also to bacteria. Now the latter may be exposed to radiation and their genes damaged, so that the biosynthetic pathways they control will be interrupted at specific points to allow accumulation and identification of reaction intermediates; or whole bacteria may be frozen solid and disrupted to release their enzymes; or for convenience of study they might be made to utilize a single carbon compound, such as ethyl alcohol, for growth.

The application of these techniques to the other species mentioned would be either unprofitable or unlawful, although for a camel on a diet of ethyl alcohol, not without interest initially. Information required for the solution of certain general problems in biochemistry can therefore be obtained just as well from bacterial experiments as from any others, with the advantage that bacteria can be handled in ways that other organisms cannot be. In any event, microbes are quantitatively much more important than mammals: they constitute almost one half of the protoplasm on the face of the earth; and without them, the atmosphere would be depleted of carbon dioxide by its utilization in photosynthesis within 30 years: this could have happened within the span of historical time even when one allows for the enormous buffering capacity of the seas for this gas.[2]

Studies in which bacterial reaction sequences have been elucidated may be collected together for convenience into three groups: those for cells whose synthetic ability is limited because they lack certain enzymes; those for cells whose chemical versatility, if not unlimited, is quite extraordinary; and studies with cell-free extracts, particularly those for cells in the second category.

Observations on the growth of bacteria with limited synthetic abilities have led to the discovery of new vitamins. Thus, the growth responses of such bacteria to an unknown factor which might be present in, say, yeast extract could be used as a guide to progress in a sequence of operations designed to isolate the factor. They have also been used to shed light on structure. Suppose a complex growth factor is composed of two simpler parts X and Y united together; and suppose bacterial strain A can synthesize Y from simple sources but not X, while strain B can synthesize X but not Y. Strain A requires a supplement of X in the medium, strain B requires Y; and it is commonly found that both requirements are removed by the addition of XY. Thus *Acetobacter suboxydans* is exacting for pantoic acid and strains of *Corynebacterium diphtheriae* for β-alanine; both can grow on addition of pantothenic acid to media since this B-group vitamin is synthesized in the cell from the other two. In turn, *Lactobacillus arabinosus* strains need the complete pantothenic acid molecule and cannot synthesize it from pantoic acid or β-alanine; however they can grow with pantetheine, which is a new XY in which X = pantothenic acid and Y = thioethanolamine.

All the compounds mentioned are constituents of the molecule of coenzyme A and these observations were valuable in arriving at its accepted structure. However, bacteria have been of even greater value in studies of certain vitamins which revealed their uses rather than their structures: thus, our knowledge of the functions of vitamins in the B group stemmed chiefly from bacterial studies. This may be illustrated by the work of Bellamy and Gunsalus[3] who showed that *Streptococcus faecalis* would not decarboxylate tyrosine when grown in the absence of the vitamin pyridoxine. The deficient cells were able to do so when the vitamin was added to the reaction mixture, and so were dried cells in the presence of pyridoxal (a derivative of pyridoxine) and adenosine triphosphate. This led to the recognition of pyridoxal phosphate as the cofactor necessary for the operation of the enzyme tyrosine decarboxylase. By similar methods it has been shown that when bacteria of limited synthetic ability were 'starved' of other vitamins of the B group certain enzymic activitities were suppressed, due to the fact that phosphorylated vitamins, or molecules derived from them, were needed as cofactors of enzymes. Strangely enough the phosphorylated forms are usually less effective for bacterial growth-stimulation than the vitamins themselves because they cannot penetrate to the cell interior: the free vitamins can do this and are phosphorylated once they are inside.

Over the last decade the scope of these studies has been greatly extended by the isolation of mutants which cannot grow unless media are supplemented with specific nutrients. Suppose glucose is converted into an amino acid, needed in the synthesis of bacterial protein, by a reaction sequence G→A→B→C→D→ amino acid. If cells are exposed to ultraviolet radiation a mutation may occur, so that the ability to synthesize the enzyme which converts B to C may be lost. Such cells fail to grow in a glucose medium unless it is supplemented with C, which may hence be identified as an intermediate in the proposed reaction sequence. A crop of the mutant cells when incubated with glucose will convert it into B, which, since it cannot be converted to C, will accumulate and may be identified. To pick out the right mutants may be tedious: irradiation may affect a great many different reaction sequences, and it is only by chance that genes of interest to the investigator will be incapacitated.

However, segregation of mutants from unchanged cells ('wild type') is facilitated by various techniques; that developed by Bernard D. Davis[4] and by Lederberg and Zinder[5] may be mentioned. Bacteria are irradiated and a suspension of them, which now contains, one hopes, mutants of interest, is inoculated into an enriched medium in which both mutants and wild type will grow. The cells are then transferred to a mineral salts medium containing the source of carbon, say glucose, but no nitrogen source (usually NH_4^+). After incubation for an hour or two the ammonium salt needed for growth is added along with penicillin. Since the latter acts only on dividing cells, bacteria with no nutritional requirements except those provided by the mineral salts medium are killed off as soon as they begin to grow, but the mutants which cannot grow survive and may be isolated.

Davis and his colleagues isolated mutants of *Esch. coli* which could not synthesize the benzene nucleus and in consequence were able to grow only when a mixture of several aromatic compounds, including tyrosine, phenylalanine and tryptophan was added to the medium. Many aromatic compounds and cyclohexane derivatives were tested to see whether they could promote growth in the absence of some or all constituents of this mixture, and eventually shikimic acid was found to be an effective substitute in the case of a number of mutants, though not for all of them. Shikimic acid (*see* Fig. 1) is not an aromatic compound and contains

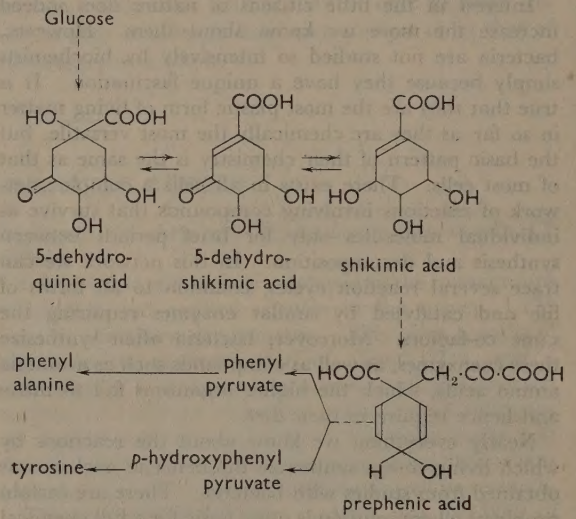


FIG. 1. Biosynthesis of the benzene nucleus. The pathway from glucose to 5-dehydroquinic acid consists of a number of known reactions; those involved in the formation of prephenic acid and its aromatization are not understood in all details

only one double bond in the ring. Before this work established its place in aromatic biosynthesis it was something of a chemical curiosity: Davis was fortunate in being able to obtain a specimen from the collection of H. O. L. Fischer, isolated by him from the bark of a Japanese plant formerly burned in certain religious ceremonies.[6] Space does not permit a discussion of the work, both with mutants and with enzymes extracted from wild-type *Esch. coli*, which established the reaction sequence of Fig. 1: here, the reactions for the conversion of glucose to 5-dehydroquinic acid are omitted. However, enzymes have been isolated from *Esch. coli*[7] which catalyse the reaction between two products of

glucose metabolism, phospho-enol pyruvate and D-erythrose-4-phosphate, to give a phosphate ester of a seven-carbon sugar; this, by the action of a second enzyme with reduced diphosphopyridine nucleotide, cyclizes to give 5-dehydroquinic acid, which is also seen to contain seven carbon atoms. Full details of the conversion of shikimic acid to prephenic acid and thence to the fully aromatized phenylpyruvic acid are awaited, but it is known that one of the hydroxyl groups of shikimic acid is first phosphorylated and that the resulting phosphoshikimic acid combines with phospho-enol pyruvate to form a ten-carbon precursor of prephenic acid.

Many types of bacteria in the soil, far from requiring any special nutrients, are able to obtain energy by oxidation of a range of organic compounds, including some not usually regarded as biochemicals. In certain studies in progress at present we inoculate media with a bacterial population the size of Leeds at breakfast time, and by supper it exceeds that of Asia, an astonishing zest for life which is supported entirely by a diet of phenylpropionic acid with mineral salts. It goes almost without saying that such a rapid rate of synthesis of the complex molecules which make up living cells must be achieved with the utmost economy of effort.

Consider the Krebs cycle, a sequence of reactions apparently common to all living cells, which serves to oxidize to CO_2 and H_2O the molecules that take part in the sequence. The reactions are linked at various points to those for harnessing the free energy released in oxidation, and some of the cycle intermediates also serve as carbon 'skeletons' for amino acids required for synthesis of proteins. We may look back upon some pathway established for the metabolism of an apparently strange article of bacterial diet, such as *p*-cresol, and we usually see that the cells have wisely concentrated their attention, if such a phrase may be permitted, on catalysing just the right initial reactions. They score over less versatile organisms in having developed the enzymic apparatus to break down the *p*-cresol into molecules that can take part in multi-purpose reaction sequences like the Krebs cycle. For the cells need to operate such cycles whatever their diet.

The man who learns of scientific developments from television or press conferences might imagine most scientists to be in permanent states of elation because they habitually confirm by experiments all the things they predict by theories. This idea would be utterly dispelled by a study, covering the past 12 years, of the place of the Krebs cycle in biochemical thought about bacteria. It is now a central conception; but in the late 1940s it was not believed to operate in bacteria because some of them, when grown on glucose as foodstuff, were able to oxidize certain compounds of the cycle only slowly and sometimes not at all. It was later realized that in these experiments some cycle intermediates had not been able to enter the cells: once inside they were oxidized, as could be shown when the bacteria were disrupted and the compounds allowed free access to their enzymes. Again, in the early 1950s the results of many experiments with the 'isotopic carrier' technique appeared contrary to the Krebs cycle. To bacterial suspensions oxidizing ^{14}C-acetate, α-oxoglutarate was added; but although this intermediate of the cycle penetrated into the cells, it contained little or no ^{14}C when re-isolated. Since by contrast succinate became readily labelled when added and re-isolated, it was thought that an abridged Krebs cycle operated in which succinate was synthesized by the condensation of two acetate molecules, thereby by-passing the reaction of acetate (as acetyl CoA) with oxaloacetate to form citrate. The abridged cycle was called the 'dicarboxylic acid cycle.'

However, all these arguments were wrong. Krampitz and his colleagues[8] disrupted large quantities of bacteria that had metabolized ^{14}C-acetate and extracted the small amount of α-oxoglutarate present in the cell contents; that is, they did not resort to adding the 'cold' (^{12}C) compound as carrier. This endogenous α-oxoglutarate was not only radioactive but in relation to respired carbon dioxide its specific activity was that predicted from the Krebs cycle. The carrier technique had been misleading because the α-oxoglutarate inside the cells was never present as the free acid but always as a coenzyme–substrate compound which did not equilibrate with added carrier. In a parallel series of experiments,[9] proof was obtained that the postulated dicarboxylic acid cycle was fictitious—just too late to prevent its getting into the textbooks as the latest news.

The climax of these studies was reached in 1955 with the reported isolation of a mutant[10] which could not oxidize acetate because it lacked the citrate-forming enzyme that catalyses the reaction between acetyl CoA and oxaloacetate. At this time therefore, it appeared that no alternative route from acetate to a four-carbon compound of the cycle existed: not only had succinate synthesis from acetate been disproved, but the formation of citrate—of all reactions the one most typical of the citric-acid cycle—had been shown to be obligatory for acetate oxidation. As might almost be anticipated from the foregoing outline of developments, however, convincing proof has accumulated in recent years that alternative routes from acetate to four-carbon molecules do in fact exist and in certain circumstances are indispensable for bacterial growth.

The need for such reactions follows if one accepts the thesis that the Krebs cycle serves the needs of synthesis as well as oxidation. From the many studies that support this view one may mention those of R. B. Roberts and his colleagues[11] who used the technique of 'isotope competition'. When *Esch. coli* grew in a ^{12}C-glucose medium to which ^{14}C-acetate was added their protein became labelled with ^{14}C. If a little

unlabelled (^{12}C) aspartic acid was then added to the culture, not only was the labelling of this amino acid suppressed in the cellular protein but also that of threonine and other amino acids assumed to be derived from aspartate. By listing the compounds whose addition to media led to a suppression in labelling, amino acids could be grouped into two main families, those derived from aspartic acid and those from glutamic acid; and these amino acids were in their turn assumed to be produced by amination of oxaloacetic acid and α-oxoglutaric acid from the Krebs cycle. These and many other observations by this group of workers fell into place when the cycle was assigned the function of providing carbon skeletons for the amino acids needed for protein synthesis.

By reference to Fig. 2*a* let us consider the fate of an acetate molecule supplied to bacteria that operate the Krebs cycle. It enters the cycle to form citrate and in

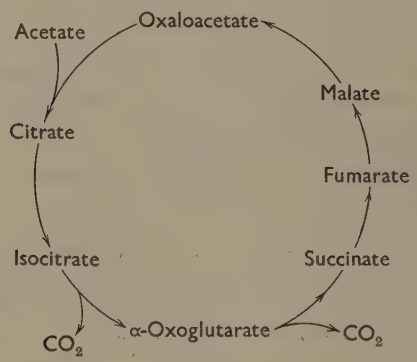


FIG. 2*a*

so doing it uses up one molecule of oxaloacetate; but after the next six reactions have occurred another molecule of oxaloacetate is produced to take its place: the *status quo* is restored, and the acetate carbon atoms have been lost as two CO_2 molecules. But now suppose that the cells are not merely oxidizing acetate but must utilize it as sole source of carbon for growth: α-oxoglutarate, for example, is removed continually as glutamate, which is built into cellular protein. At first α-oxoglutarate may be replenished by the reaction sequence:

acetate + oxaloacetate → citrate → isocitrate → α-oxoglutarate

but this cannot continue indefinitely. Enough acetate may be supplied externally from the growth medium but the cells contain only a limited amount of oxaloacetate to react with it, and when the supply runs out growth must stop if α-oxoglutarate is indeed the source of all the glutamate needed for protein. However, many bacterial species can grow well with acetate or ethanol, or on straight-chain monobasic acids which are broken down entirely to acetate,[12] as sole sources of carbon.

The crux of the problem is this: how is the cycle replenished with oxaloacetate derived solely from acetate? We have seen that a simple condensation of two acetate molecules to give succinate, and hence oxaloacetate, can be ruled out. It might also be mentioned that in addition to these theoretical arguments, a search for reactions by which the cycle could be replenished was encouraged by certain direct observations. Thus, when some bacteria oxidized acetate they synthesized and excreted α-oxoglutarate in amounts sufficient for its isolation as a crystalline 2,4-dinitrophenyl hydrazone.[13] However, this ability was only acquired after growth on acetate as sole source of carbon: evidently these cells contained enzymes that were largely absent from those grown with other carbon sources.

The solution of the problem awaited the discovery of two enzymes, isocitrase[14] and malate synthetase[15] (Fig. 3*a*,*c*). The former is an organic acid aldolase

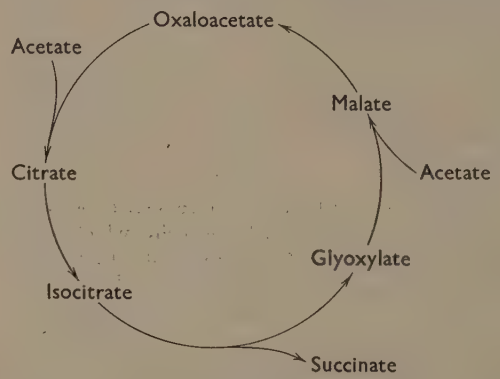
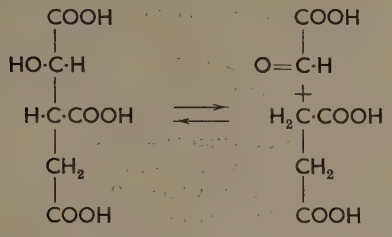


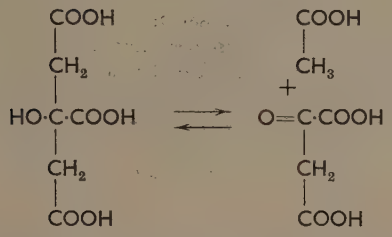
FIG. 2*b*

like citrase[16] (Fig. 3*b*) which differs from the citrate-forming condensing enzyme (Fig. 3*d*), because it does not require coenzyme A but only a divalent metal ion (*e.g.* Mg^{2+}) as co-factor. Citrase is induced in certain bacteria by anaerobic growth on citric acid, isocitrase by aerobic growth on acetate or straight-chain fatty acids.[12] Malate synthetase can be seen from Fig. 3 to catalyse a reaction of the same type as the condensing enzyme. When cells utilize acetate for growth the following reactions occur. An acetate molecule from the growth medium reacts with, and so uses up, one molecule of oxaloacetate inside the cell to give first citrate and then isocitrate; and this is decomposed by isocitrase to give glyoxylate and succinate. By reactions of the Krebs cycle, succinate is converted to oxaloacetate and the vacancy caused by the first reaction of acetate is filled. The net result has been to convert the acetate to glyoxylate. Malate synthetase now catalyses the reaction of this glyoxylate with another molecule of acetate, as acetyl CoA, to give malate, which in turn can be converted in the Krebs cycle to oxaloacetate. A molecule of the latter has now been gained

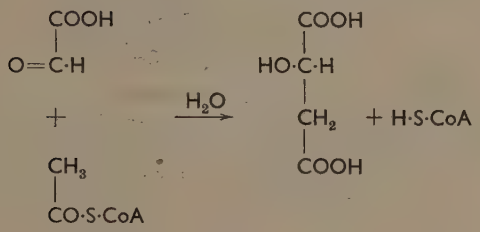
at the expense of two molecules from the external acetate pool; when it reacts with a third molecule of acetate,



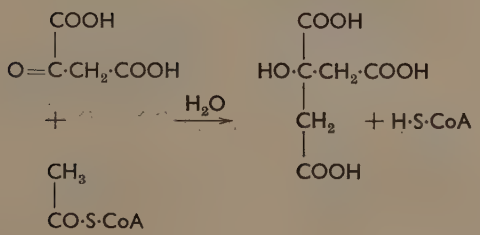
(*a*) isocitrate ⇌ glyoxylate + succinate



(*b*) citrate ⇌ oxaloacetate + acetate



(*c*) glyoxylate + acetylcoenzyme A ⟶ malate + coenzyme A



(*d*) oxaloacetate + acetylcoenzyme A ⟶ citrate + coenzyme A

FIG. 3*a*—*d*

an additional molecule of, say, α-oxoglutarate may be made available by reactions of the cycle for use in synthesis of cell constituents. Alternatively these additional reactions may be expressed in the form of a cycle (Fig. 2*b*) in which succinate (C_4) is seen to be synthesized indirectly from two acetate molecules. It is now evident why the mutant which lacked the condensing enzyme could not oxidize acetate: this enzyme is a member of the glyoxylate cycle as well as the Krebs cycle.

The glyoxylate cycle is a route by which carbohydrate may be formed from fatty acids in bacteria, moulds and plants but apparently not in animals. Proof of its operation is due largely to H. L. Kornberg and his colleagues at Oxford (now at Leicester), and their papers[17] serve as a model of how radiotracers should be used to study bacteria. When *Pseudomonas fluorescens* growing on acetate as sole carbon source was incubated for brief periods with ^{14}C-acetate the isotope was incorporated into compounds which could be extracted from the cells with ethanol. Chromatography of Krebs-cycle acids in the extract showed that in the first few seconds of exposure to the isotope, 40 per cent of the incorporated ^{14}C was present in malate and 30 per cent in citrate. At that time, other acids contained far less tracer but 30 seconds later the proportion present in them had risen, and that in malate and citrate had fallen, to steady values. These and many other experiments proved that, as the glyoxylate cycle requires, acetate is incorporated into malate by an early reaction sequence.

The central feature of the glyoxylate cycle is the conversion of acetate to glyoxylate, through which, by reaction of further acetate from the medium, C4 and C5 Krebs-cycle compounds become available for synthesis of cellular material. However, suppose cells grow in a medium that supplies only glyoxylate: if the glyoxylate cycle is to be operated, how will the required acetate be generated? This question is by no means hypothetical, since various soil bacteria can utilize glycine,[18] glycollate[19] or oxalate[20] as sole sources of carbon and can be shown to convert each of them initially into glyoxylic acid. The problem was solved when the enzyme glyoxylate carboligase[21] was discovered, by which two molecules of glyoxylate by loss of CO_2 are converted to a three-carbon compound, presumably the highly unstable tartronic semialdehyde; this is enzymically reduced to glycerate which may be converted by well-known enzymic reactions to pyruvate and hence to acetate (Fig. 4). This acetate has arisen solely from glyoxylate, with which it can now unite to operate the glyoxylate cycle.

Bacteria may be disrupted in a number of ways so that the soluble enzymes inside them can be extracted: thus, the cells are broken open when exposed to ultrasonic vibrations or when ground with powdered alumina, or in the Hughes press,[22] where frozen bacterial

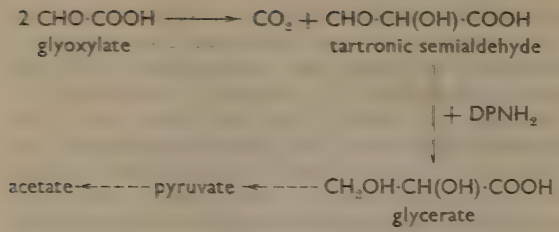


FIG. 4

pastes are made to pass at −14° C between two machined stainless steel plates bolted together, the cells being ripped open by ice crystals under the great shearing forces to which they are subjected. Work which clarified the reactions for biosynthesis of the benzene nucleus has been outlined, and it would seem fitting to mention how cell-free extracts have been used to reveal reactions by which the nucleus is degraded.

It would be a very bored chemist—familiar since adolescence with the idea of resonance and knowing how the aromatic nucleus survives treatment with highly corrosive chemicals—for whom there was no fascination in following the disappearance of oxygen gas as it participates in a reaction, catalysed by enzymes from bacteria, in which benzene nuclei are smoothly and rapidly opened up at 30°C in neutral solution. The route by which an aromatic compound is degraded may first be mapped out using whole cells by the technique of 'simultaneous adaptation.'

Briefly, compound A may be oxidized by a succession of reactions, A→B→C→D→, which implies that intermediates B, C and D will be oxidized by the cells about as rapidly as A. In principle, rates of oxidation are measured in respirometers first for A and then for all the intermediates one might guess to be involved in the sequence; those compounds which are oxidized as fast as A turn out to be good guesses, those oxidized slowly, wrong ones. Of course, enzymes must be shown to be of the 'induced' type. This can be done by growing cells on D and showing that ability to oxidize A, B and C is largely abolished. This is essential since otherwise

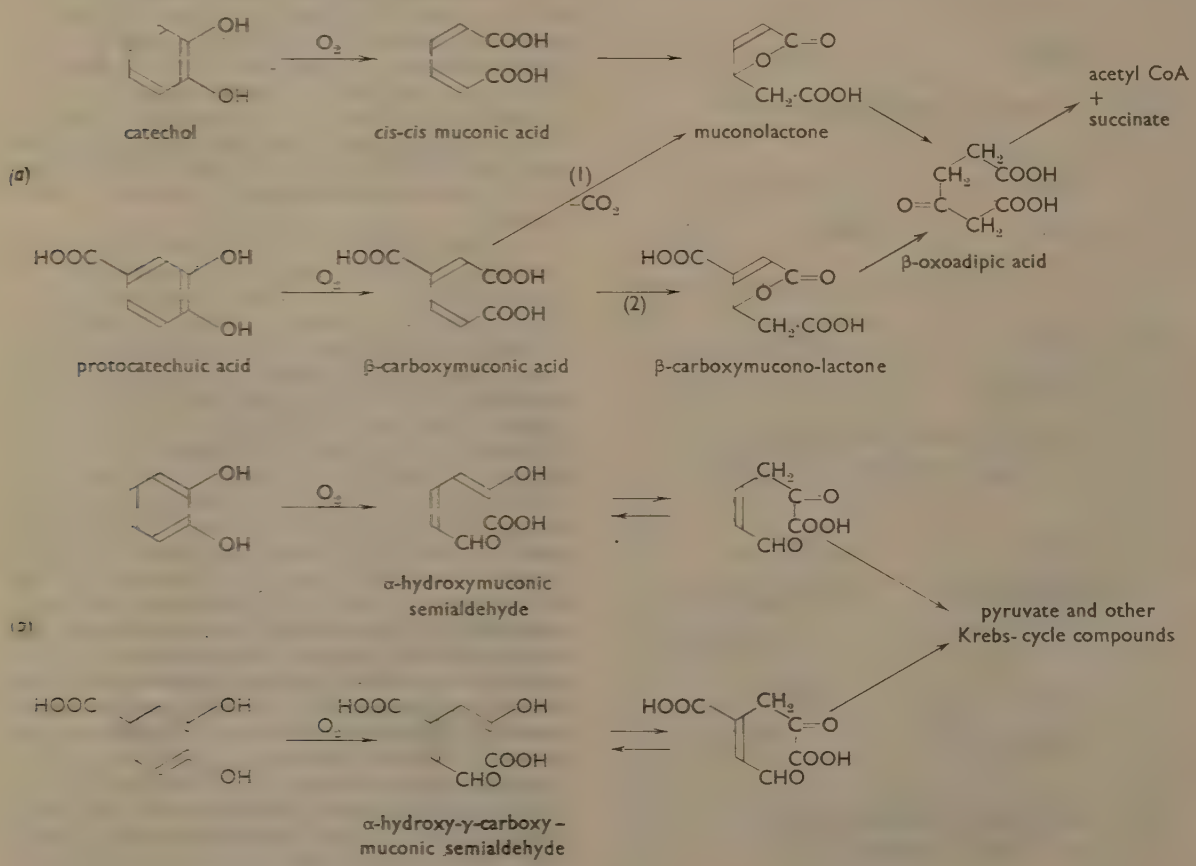


FIG. 5

B, say, might be oxidized by 'constitutive' enzymes always present in the cells, no matter what their diet, and ability to oxidize B might have nothing to do with its status as an intermediate in the proposed sequence.

However, the limitations of simultaneous adaptation were mentioned when the Krebs cycle was discussed: a compound may fail to be oxidized simply because it fails to enter the bacteria, and one cannot exclude it from a reaction sequence without also doing work with isolated enzymes. Such studies show that before the benzene nucleus breaks open, a dihydric phenol is formed by enzymes that catalyse hydroxylations: thus, mandelic[23] or benzoic[24] acids are converted eventually to catechol; *p*-hydroxybenzoic acid[25] or *p*-cresol[26] to protocatechuic acid (3,4-dihydroxybenzoic acid); and tyrosine or phenylalanine[27] to homogentisic acid (2,5-dihydroxyphenyl acetic acid). Crude extracts from soil bacteria contain a mixture of enzymes that catalyse most of the reactions of Fig. 5*a* so that catechol, or protocatechuic acid, is converted into β-oxoadipate. The individual reactions of the sequence have been studied by separating the enzymes from one another by such methods as fractional precipitation with ammonium sulphate or by absorbing one particular enzyme on to, say, alumina gel, from which it can later be eluted. Identification of reaction products and assays of individual enzymes have depended greatly upon spectrophotometry, since the muconic acids show characteristic ultra-violet absorption[28]; however, there are also valuable chemical tests, such as hydroxamate formation by lactones and the sensitive Rothera reaction of β-oxoadipate.[29]

Recent work[30] has shown that many soil bacteria do not open the benzene nucleus between adjacent carbon atoms carrying hydroxyl groups as in Fig. 5*a*. Although the presence of two hydroxyl groups appears to be a prerequisite, ring opening by many species does not entail the production of two carboxyl groups, but instead an aldehydo-hydroxyacid is formed, as shown in Fig. 5*b*. The pathway from the first product of this type of ring fission to the Krebs cycle has not yet been established, but one can at least draw a parallel between the initial reaction and one that has been demonstrated for mammalian systems,[31] namely the oxidation of 3-hydroxyanthranilic acid to α-amino-β-carboxymuconic semialdehyde. The reactions of Fig. 5*a* play little or no part in mammalian metabolism. A survey of aromatic biochemistry, more than any other branch of the subject, leaves one with the feeling that anything that mammals can do, bacteria can do: if not better, at least in several different ways.

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Book Reviews

REFERENCE ELECTRODES : THEORY AND PRACTICE. Edited by D. J. G. Ives and G. J. Janz. Pp. xi + 651. *New York: Academic Press Inc.; London: Academic Books Ltd*, 1961. 143*s*.

Of the making of competent scientific textbooks there is no end, but very occasionally a work appears which can legitimately be regarded as a landmark in a particular field. The present book belongs to this very select category. It is far more than its rather limited title suggests. Anyone searching for information about the preparation and properties of reference electrodes will certainly not be disappointed, but the volume goes much further than this. It is in fact an integrated account of practically all the electrode systems which have interested electrochemists in the last 50 years, considered from the experimental, the thermodynamic and the kinetic viewpoints.

Chapter 1, by Ives and Janz, sets the framework of the book by considering the concept of electrode potential, its definition and measurement, and the characteristics which determine whether a particular electrode will be highly reversible or not. It is noteworthy and typical that the chapter ends by considering the desirable features in experimental cells, and this welcome combination of theoretical considerations and actual experimental requirements is repeated continually throughout the work. There then follows a chapter on the hydrogen electrode by Hills and Ives, which, in the relatively short space of 55 pages, gives the best account which the reviewer has read of this subject, including the consideration of hydrogen overpotential. In contrast to much of the arid discussion of reaction kinetics that has become fashionable in recent years, this account endeavours to convey understanding of all the aspects of the ionization of hydrogen and the discharge of hydrogen ions, and it succeeds to a remarkable degree. The same success is noteworthy in chapter 7, by Ives, in which oxide, oxygen and sulphide electrodes are considered. Here again an enormous mass of information has been most skilfully put together to give an integrated picture which, while in no sense a final one, is always intelligible and provides the reader with a reliable guide to a complex and difficult field.

Of the more conventional reference electrodes, calomel and other mercury–mercurous salt electrodes are very thoroughly treated, as also are silver–silver halide electrodes, and these accounts include the discussion of very recent work on the anodic formation of halides; electrodes involving sulphate ions are also considered. The quinhydrone and associated electrodes receive authoritative treatment, and Bates gives a brief but very comprehensive survey of the features of the glass electrode and the techniques involved in its use. Hills contributes most useful chapters on membrane electrodes and reference electrodes for use in non-aqueous solvents, in which much hitherto scattered information is brought together in a very helpful way. The physiologist, who makes much use of potential measurements, has previously been largely ignored in electrochemical texts, but this is rectified in the present work in the chapter by Cater and Silver on electrodes for use in biology. This contains a wealth of information on electrodes suitable for pH and redox potential measurements and for the determination of action and bioelectric potentials in living systems. Finally the last chapter by Laity deals with electrodes in fused-salt systems and here again the treatment ranges from the discussion of ion activities in melts to details of the construction of reference electrodes.

The book is excellently printed and illustrated and generally easy to use, although the copy reviewed was defective in that pp. 149–184 had been omitted in binding! References are grouped at the end of each chapter and seem to be comprehensive. The volume should be compulsory reading for all interested in the physical chemistry of electrode processes, and it is to be regretted that its very high price is likely to limit its circulation.

A. HICKLING

PROGRESS IN REACTION KINETICS. VOLUME I. Edited by G. Porter. Assistant editor B. Stevens. Pp. viii + 276. *Oxford: Pergamon Press*, 1961. 70*s*.

This book, the first in a projected series, is divided into nine chapters, each dealing with a specific topic. That on reactions of oxygen atoms, by F. Kaufman, deals with experimental methods for producing oxygen atoms and for the measurement of their concentration. The recombination reactions which occur on surfaces and homogeneously in the gas phase are discussed in detail, together with reactions involving oxides of nitrogen, hydrogen, oxides of sulphur, chlorine and paraffin hydrocarbons. V. V. Voevodsky and V. N. Kondratiev, in their contribution on the determination of rate constants for elementary steps in branched-chain reactions, are concerned mainly with a critical survey of the hydrogen–oxygen reaction, in which attention is focused on the values which have been obtained for the rate constants of the elementary reactions.

A concise account of a new and important field of study is given in the chapter on the kinetics of the reactions of ions with molecules, by F. W. Lampe, J. L. Franklin and F. J. Field. Experimental methods are described for these studies, and useful tables are provided which list reactions and rate constants. Reactions of alkyl radicals are dealt with by J. A. Kerr and A. F. Trotman-Dickenson in a critical summary of the quantitative information available about the interactions of alkyl radicals. This covers combination and disproportionation, atom abstraction, addition to unsaturated

molecules and decomposition. Comprehensive tables make for easy reference.

A theoretical chapter on the effects of diffusion rates on chemical kinetics is contributed by R. M. Noyes. Two models are described and developed, and the results are discussed for reactions in the gas, liquid and solid phases. The reaction types dealt with include free radical, ionic and excited state. C. W. Davies discusses several well-known ionic reactions in solution and the effect of ionic strength on their velocity constants in a chapter on salt effects in solution kinetics. In a chapter on fast reactions of excited molecules, A. Weller describes reactions of such molecules where the reaction can be investigated by observing fluorescence emission from the excited state. The reactions dealt with include fluorescence quenching, complex formation, acid–base interactions and isomerization.

Nucleophilic substitution at a saturated carbon atom in non-hydroxylic solvents is dealt with by Y. Pocker, who describes reactions of this type in terms of the S_N1 and S_N2 mechanisms, and discusses the effect of environment on their kinetics and the individual steps in these reaction sequences. L. Peller and R. A. Alberty, in their chapter on physical chemical aspects of enzyme kinetics, summarize the way in which kinetics can be applied to these very complex reactions in an attempt to obtain more details about the mechanisms involved. The effects of certain variables are shown to give additional information.

This book is well produced and fills a need for a regular review series in chemical kinetics. The articles are well written and concise, good use having been made of tabular presentation. A useful feature at the end is a classified index of reactions referred to in the text. The volume is good value, and will be welcomed by those interested in kinetics. James C. Robb

VALENCY AND MOLECULAR STRUCTURE. Second Edition. E. Cartmell and G. W. A. Fowles. Pp. xii + 294. *London: Butterworths*, 1961. 32*s*. 6*d*.

The second edition of this popular book has the same basic arrangement as the first. Part I, which has undergone little change, gives an introduction to quantum theory and atomic structure. Part II provides a discussion of the theory of valency; here the section on electronegativity is extended to include Sanderson's work, the treatment of hydrogen bonding is more thorough, and a useful introduction to the metallic bond is added. Part III, which has been largely re-written, deals with the application of the principles to typical inorganic and organometallic compounds. A new section on ligand-field theory is included, and effective use is made of the concept of crystal field stabilization energy. The reactivity of complexes is not neglected; there is a well-written account of the trans-effect.

Little mention is made of oxidation state or charge number. A bipositive ion is called a bivalent ion, and a metal in an oxidation state of + 2 is said to be bivalent. This usage is particularly confusing in the introduction to complex compounds. Iron is said to be tervalent in $[Fe(CN)_6]^{3-}$, and to form six bonds. The oxidation state of iron in the hexacyanoferrate(III) ion is certainly + 3, as indicated by the Roman numeral. The use of the word valency for this concept creates unnecessary ambiguity.

The introduction to magnetochemistry given in the first edition has not been extended, though some addition might have been expected. The 'spin-only' formula could not be applied, even as a reasonable approximation, to some of the complexes discussed.

The book is attractively presented and there are very few typographical errors; the diagrams are well drawn and well integrated with the text. The price of this new edition is unchanged, though 40 pages have been added. The new cover looks rather less durable, but the book remains good value.

This book succeeds in giving, in an attractive, lucid style, the basic theory for understanding the fascinating new work going on in inorganic chemistry. It is strongly recommended as an addition to the personal libraries of all students of the subject.

R. B. Heslop

RADIATION BIOPHYSICS. H. L. Andrews. Pp. xii + 328. *Englewood Cliffs: Prentice-Hall Inc.; London: Prentice-Hall International Inc.*, 1961. 75*s*.

Dr Howard Andrews is the radiation safety officer, National Institutes of Health, U.S.A. He has written a book which aims to set down clearly and concisely those physical principles essential to the understanding of the biological effects of atomic radiation and the safe use of radiation sources. In large measure he has succeeded in his task, and the reader is put into the position of being able to test his understanding by trying the questions (answers supplied) at the end of each chapter. The standard references enable one to go deeper into aspects of radiation biophysics, and there are also special references interspersed with the text. The references are, with very few exceptions, to U.S.A. literature and there are few references to work published in the years 1955–1960. The author has included enough mathematics, working diagrams and tables of data to satisfy the serious student without over-burdening the general reader.

In the first 100 pages the author passes from a statement of basic principles, a description of various methods of X-ray production and an account of natural and artificial radioactivity to the theories of photon absorption. Problems of radiation shielding and radiation therapy using radon seeds are given. The next 150 pages are devoted to measurements of β-, γ- and neutron radiations with ionization chambers, pulse counters, scintillators and chemical methods. The problems include the estimation of body burdens, the

dead time of a G-M counter and thyroid dose due to radioactive iodine.

The remainder of the book deals with the effect of radiation on single cells, including the inhibition of mitosis, chromosome aberrations and genetic consequences, passing on to the effect on mammals. There are chapters devoted to radiation-injury pathology and radiation protection. The reader is introduced to U.S.A. radiation safety regulations, but he will need to study the corresponding British literature to become acquainted with the regulations in this country dealing with occupational and public health protection.

The book is relatively free from errors, but Rutherford is mis-spelled on p. 74 and the first sentence on p. 124 is misleading. The sentence on p. 156 '. . . principles back of . . .' falls strangely on British ears. Certain sections, such as that on the chemical effects of radiation, are superficial and the alternatives to the target theory are neglected.

However, the author and the publishers are to be congratulated on a very clear presentation of the subject, and those engaged in this relatively new field of atomic energy will welcome the bringing together of data normally spread over many books and papers.

A. QUINTON

CARBON-14 COMPOUNDS. J. R. Catch. Pp. vii + 128. *London: Butterworths*, 1961. 30*s*.

This is an excellent account of the production and properties of compounds labelled with the radioactive isotope of carbon, ^{14}C. The book is lucidly written and well produced, and it can be recommended as an introduction to all who contemplate tracer work with this isotope.

After a brief general introduction, the formation of carbon-14 by irradiation of nitrogenous compounds in atomic reactors is described in a short chapter, but the major part of the book deals with the conversion of the primary product, radioactive carbonate, into a wide variety of labelled organic compounds. As is probably well known, many of these are now commercially produced at the Radiochemical Centre in England and by several firms in the United States and in other countries. It is still often necessary, however, for the individual research worker to synthesize compounds for tracer work, and the choice of a suitable method sometimes seems difficult. For this reason, the clear and authoritative discussion of the available methods of chemical and biological synthesis will be very welcome. The general rules governing the choice of method are illustrated by well-chosen examples, and practical aspects of handling both volatile and non-volatile carbon-14 compounds are also dealt with. This section is well illustrated with diagrams and photographs of apparatus used in isotopic syntheses. A separate chapter covers peculiar features of carbon-14 compounds, such as isomerism, double labelling, isotope effects, radiation decomposition and the nomenclature of labelled compounds. Two chapters on the analysis and measurement of carbon-14 compounds include useful discussions of chemical and radiochemical purity and of counting methods. The only omission of any importance is in the chapter on measurement where, in the reviewer's opinion, the effect of back-scattering deserves mentioning. The final chapter on precautions in the use of carbon-14 compounds is of practical value to all intending users of this isotope. Its general conclusion that the equipment of a good chemical laboratory is sufficient for tracer work is reassuring, and should encourage an even wider application of ^{14}C-labelled compounds in research.

H. R. V. ARNSTEIN

THE CHEMICAL AND BIOLOGICAL ACTION OF RADIATIONS. VOLUME V. Edited by M. Haïssinsky. Pp. xi + 278. *Paris: Masson et Cie; London: Academic Press Inc. (London) Ltd*, 1961. 63*s*.

This volume of the series is composed of four reviews of different aspects of radiation chemistry, and although aimed at the specialist, it contains sections which will interest those outside this field. Thus Part I, 'The Radiolysis of Water by Gamma Rays or Electrons,' by A. O. Allen, is a very readable and succinct account of the basic radiation chemistry of liquid water (17 pp.).

Part IV, 'Mass Spectrometry and Radiation Chemistry,' by D. P. Stevenson and D. O. Schissler (100 pp.), is heavier going, but it provides a useful summary of information obtainable by mass spectrometry about ionization processes. Such information is essential to the understanding of the primary processes occurring in radiation chemistry and this collection of experimental data and theoretical discussions of ionization cross-sections, appearance potentials, cracking patterns and ion–molecule reactions will be welcomed by radiation chemists.

Part II, 'The Action of Alpha Particles on Aqueous Solutions,' by J. Pucheault (133 pp.), is more specialized. It is a critical review of the experimental observations in such systems; it emphasizes the fact that, although qualitatively similar to γ-rays and electrons, the quantitative interpretation of the effects of more densely ionizing radiations is not so simple. The differences arise from the much higher concentrations of reactive species produced by the heavier particles in localized regions where the energy is dissipated, and with certain assumptions about the distribution of the species and their reactions the author has been able to bring some order into the picture.

Non-homogeneous distribution of reactants is a general feature of the radiation chemistry of liquids, and some progress has been made towards a theoretical understanding of its effects by the application of diffusion kinetics to model systems. The various approaches are summarized and criticized in Part III, 'Diffusion

Kinetics in Radiation Chemistry,' by A. Kuppermann (80 pp.). The treatment here is so detailed that much of the article will appeal only to those engaged in these calculations. One wonders whether this is desirable in a book of this nature since, as stated by the author, most of the calculations done so far were aimed, not at obtaining exact quantitative agreement between theory and experiment, but at developing a feeling for the properties of the model. However, the last section, where theory and experiment are compared, is more general and points to the kind of experimental data required for an adequate check on the model.

The book is well produced, as it should be for the price, and the series as a whole is providing valuable reviews of this rapidly expanding subject.

J. H. BAXENDALE

POLYMERIC MATERIALS. C. C. Winding and G. D. Hiatt. Pp. x + 406. *New York: McGraw-Hill Book Co. Inc.; London: McGraw-Hill Publishing Co. Ltd*, 1961. 93*s*.

Dr Winding is at Cornell University and Dr Hiatt is engaged in industry. They have for a number of years given courses of lectures to a wide cross-section of students—chemists, physicists, engineers and so on. They are therefore fully familiar with those aspects of high polymers which must be put over in the lecture room, and also with the actual uses of these materials on a large scale. These conditions seem to ensure a balanced treatment of the subject.

This book is based on the authors' lecture notes in these introductory courses on polymeric materials. The authors state that students have readily accepted the order of presentation, which involves the early introduction to polymeric chemistry, molecular structure and properties. I can well believe this, because the early chapters dealing with these difficult subjects are handled in an excellent manner and are most lucid and logical. What appeals to me is that the treatment of the subject is quite adult and free from whimsy. But the reader must have a sound knowledge of chemistry and physics, otherwise he may find it tough going. It is always possible to present a lecture in a way that will be more readily accepted than the same material in print.

I think the original conception is extremely sound, namely, that polymeric materials are the basis of four major industries—paint and varnish, fibres, rubber and plastics. In my view, this is the correct emphasis and tends to focus the interest in the right way. It is no longer possible to be in any of these industries and remain blithely unconcerned with the others. They are all interchanging polymers at a growing rate and any one industry must try to keep abreast with the others.

The chemical and physical side is followed by a section on the general properties of plastics. In this about 30 general characteristics are dealt with in 23 pages. Hence the treatment has to be curtailed, although it is well done within the limits of the space employed. One can see the economy of words brought about by the use of undoubtedly excellent lecture notes. The next two chapters are devoted to general application of polymeric materials and give a survey of the leading methods employed in handling. Thereafter the individual families of plastics and rubbers are described.

This is an excellent book and can be highly recommended for all readers with a good chemical and/or engineering background. It provides a readily accessible source of background information for polymeric materials in these particular industries. Clearly the limitations of space make it impossible to treat any of the subjects in any depth, but the fundamentals are there and extremely well set out.

HARRY BARRON

PROGRESS IN DRUG RESEARCH. VOLUME II. Edited by E. Jucker. Pp. 636. *Basle: Birkhäuser Verlag*, 1960. DM 85.

This book, the second volume of the four of this series (the first was published in 1959), is written by specialists for specialists. Each of the nine monographs (five in English and four in German) has been compiled by a worker or workers eminent in the particular field; it is therefore authoritative and indispensable to anyone carrying out work on the synthesis of drugs. The emphasis is almost entirely on chemistry, with some indications of the pharmacological action of the compounds.

The general reader will find it difficult to obtain a clear picture of progress as measured by those compounds that have proved valuable in medical practice. It is true that the section by W. Kunz entitled 'Über neue Arzneimittel' is a general review of the newer drugs with, in many cases, their official and proprietary names, but the article is uncritical and gives little help in assessing the relative value of the different drugs.

This, however, is not the purpose of the book, which is to give a comprehensive account of recent chemical work in special fields; in this it succeeds admirably, and the editor and publishers are to be congratulated, firstly on producing a book that is so up to date—many of the references cited are dated 1960—and secondly on its freedom from errors and misprints, both in the text and in the structural formulae. It is a pity that it will be out of date so soon.

The monographs are: Newer Diuretics (K. H. Beyer and J. E. Baer); Anabolic Steroids (B. Camerino and G. Sala); Chemical Nature and Pharmacological Actions of Quaternary Ammonium Salts (C. J. Cavallito and A. P. Gray); Über Vorkommen und Bedeutung der Indolstruktur in der Medizin und Biologie (A. Cerletti); Über neue Arzneimittel (W. Kunz); Ganglienblocker

(K. Nador); Monoamino-oxydase-Hemmer (A. Pletscher, K. F. Gey and P. Zeller); The Structure and Biogenesis of Certain Antibiotics (W. A. Sexton); and Antimetabolites and their Revolution in Pharmacology (D. W. Woolley).

References are numerous; the monograph on amino-oxidase inhibitors has no less than 1,389!

It is difficult in a work of this kind for authors to avoid writing what is merely an expanded list of references and to produce a readable monograph. Some, but not all, of these authors have succeeded.

NORMAN EVERS

THE SCIENTIFIC BASIS OF MEDICINE: ANNUAL REVIEWS 1961. British Postgraduate Medical Federation. Pp. xi + 342. *University of London: Athlone Press*, 1961. 40*s*.

This book is the first of a new series replacing the *Lectures on the Scientific Basis of Medicine*, eight volumes of which were published between 1953 and 1960. The content of the book is similar to that of its predecessors, containing selected lectures of the course organized by the British Postgraduate Medical Federation and delivered between October, 1959, and March, 1960. This volume contains 19 of the 30 lectures given during that period.

The reviews cover selected topics in the fields of biochemistry, physiology, pharmacology and pathology, and are introduced and concluded respectively by more personal accounts of research by Sir Lindor Brown and Sir Roy Cameron, both of which make delightful reading. Two papers by Dame Janet Vaughan and Doll are concerned with radiation, the former with its destructive effect on cells and the latter with its relationship to leukaemia. Lajtha discusses the use of radioactive isotopes in the investigation of abnormal cells in the bone marrow. Wilkinson writes on the changes in blood enzyme concentrations which occur in disease. Dalgliesh's lucid account of the biochemical aspects of amino-acid metabolism should be read in conjunction with Milne's excellent review of disordered aromatic amino-acid metabolism. Stoner's paper on the biochemical response of the body to injury is thorough and interesting. The liver is discussed by Sherlock and Harkness. Sherlock describes its role in metabolism and the consequences of disordered metabolism. Harkness writes on the phenomenon of regeneration after partial removal of the liver and discusses the possible factors concerned. There is a topical account by James of the dietary substances which affect the plasma lipids. Fourman presents a detailed account of the newly-recognized syndrome of magnesium deficiency in animals and man. Other articles discuss the biochemistry of multiple sclerosis and genetic analysis via somatic cells. There are articles with a more clinical bias on diabetes and the action of drugs on the heart. Virology is represented by a paper on the antiviral action of interferon, and immunology by a discussion of immune cellular reactions.

When so many diverse subjects are brought together in one volume there are inevitably variations in approach. Some of the authors attempt to cover broad fields in a few pages, while others are concerned with highly specialized fields and will consequently appeal to a few readers only. In altering the title of the series the publishers hoped that the papers presented would reach a wider audience than formerly, but the uneven presentation is unlikely to satisfy either the critical research worker or the scientist who is interested in the background of modern medicine. It is disappointing that there should have been a delay of 18 months between delivery of some of the papers and their publication.

The book is well produced and clearly printed. The reviews in general are concise and have an adequate bibliography, but one minor criticism may be levied at the lack of uniformity in the presentation of the references at the end of each paper. There are 18 good black-and-white plates. There is also a useful author and subject index of all the articles published in the earlier series.

D. S. YOUNG

TOXICOLOGY: MECHANISMS AND ANALYTICAL METHODS. VOLUME I. Edited by C. P. Stewart and A. Stolman. Pp. xvii + 774. *New York: Academic Press Inc.; London: Academic Books Ltd*, 1960. 157*s*. 6*d*.

An unwelcome by-product of the ingenuity and activity of chemists is the increasing number of toxic hazards to which mankind is exposed. This has added greatly to the responsibilities of the toxicologist, and much may depend on the skill and resources he can bring to bear on his task. It is fortunate that while the number of toxic agents has increased, so also has the number of techniques available for their identification and determination. For the most part, however, these have not been developed primarily for this purpose, and the need arises for ensuring that those concerned with toxicological problems shall be fully aware of the powerful modern techniques available to them. This is the task which the editors of 'Toxicology' have undertaken and, in preparing the two volumes which make up this treatise, they have enlisted the help of a group of American, Canadian and British experts.

Apart from a short introductory account of the toxicologist and his work, Volume I is divided into two parts. The first of these consists of a series of chapters dealing with the absorption, distribution and excretion of toxic substances and with the metabolic changes they undergo in the body. These chapters have been written by the editors themselves, and reflect the increasing awareness of the importance of what might be termed the dynamic aspects of toxicology. In the second part of the book, other authors deal with such topics as

chromatography, ion-exchange resins, paper-ionophoresis, counter-current distribution, spectrum analysis in its various forms, X-ray diffraction analysis, polarography and microdiffusion analysis. The underlying principles of each technique are described and, so far as it is possible to do so, examples are given of its toxicological applications. There are also chapters which deal with the systematic search for an unknown poison in viscera, the separation of poisons from biological material, optical-crystallographic methods of drug identification, and the estimation of basic drugs by dye methods.

This book more than points the way for the toxicologist who seeks to use new methods to attack familiar problems. By its emphasis on principles it does much to help him to meet the challenge presented by hitherto unknown poisons. Because of this, as well as because of its all-round excellence, it is safe to predict that for some time to come this book will serve as a guide and friend not only to professional toxicologists, but also to others whose work brings them into contact with toxicological problems.

LESLIE YOUNG

THE USE OF OXYGEN IN THE ELECTROMETALLURGY OF STEEL. G. M. Borodulin. Translated by G. F. Modlen. Translation edited by H. T. Protheroe. Pp. viii + 112. *Oxford: Pergamon Press*, 1961. 50*s*.

It is an interesting comment on the difference in approach between Russia and the West that this book could appear only as a translation of a Russian volume. It is true to say that the contents are not new in principle to any of those versed in the art of alloy steelmaking in either Britain or the United States; in addition, it cannot be denied that such work was pioneered in America around 1943–45 and was put into practice in this country before 1950, whereas the Russian work dates from 1952 at the earliest. On the other hand, in neither of these Western countries has any such native report as this Russian one emerged, presumably indicating the difference in outlook between private enterprise with its competitive attitude and a publicly-owned steel industry with its readiness to share the findings of one works throughout the industry.

The contents are thus only of passing interest to the expert in the field, but provide the student and the interested reader from allied fields with a body of information not likely to be made available otherwise. An introductory chapter covers the general use of oxygen in arc furnaces in Russia. This is followed by detailed procedures for a number of various steel compositions, this being the most surprising feature. A third chapter covers the quality aspect, again a valuable section. The next chapter, on the economic aspects of oxygen steel metallurgy, is of rather doubtful significance, in view of the lack of a true exchange value for sterling against the rouble. The two final chapters, on mechanization and safety precautions, are fairly routine in nature although it is interesting to note that 180-ton arc furnaces are envisaged in Russia. A further intriguing point is that the development of the electromagnetic stirring device is described as current work in the Soviet Union with a grudging notice of the Swedish work. All the references on this topic are to Russian papers—almost akin to the pre-war claim that Shakespeare was a German, with its corollary that the English translations were quite good!

The style of translation in this case is also commendable, except for some lack of the idiomatic phrase here and there. Thus 'white crumbly slag' would usually be termed 'falling slag,' 'guttering' is better read as 'runners'; the term 'cracking steel' rather escaped the reviewer until he realized this was the steel with 5 per cent chromium used in catalytic cracking equipment. It is felt that a table of standard analyses with the Russian designations would be of assistance; in addition, translation of the mechanical test results into British units is desirable. Numerical errors occur with regard to the phosphorus contents in Table IV and the saving of time in the melt-down and boil periods in Table XXVIII; these presumably derive from the Russian original.

In summing up, it can be said that anyone involved in the study of alloy steelmaking will find this volume interesting, if not from the technical standpoint, at least as an example of the approach to these matters on the other side of the Iron Curtain.

K. C. BARRACLOUGH

GAS CHROMATOGRAPHY. E. Bayer. Pp. xii + 240. *Amsterdam: Elsevier Publishing Co.; London: D. Van Nostrand Co. Ltd*, 1961. 25*s*.

In this relatively inexpensive book the author attempts to cover gas chromatography completely in 238 pages. In the process, much of the description and many of the explanations of gas chromatographic procedures have been condensed to such an extent as to give incorrect implications. This may be due, in part, to errors in translation. In the description of the argon detector, although this is factually correct, it is implied that the radioactive source produces metastable argon atoms. This is not so, for their production depends on the accelerating voltage across the detector electrodes, and this voltage does not merely act as a collecting voltage. Columns are not packed with 'stationary phase' as stated, but with an 'inert support carrying a stationary phase.' Far too little attention is given to the theory of gas chromatography, and the treatment of this topic is far from complete.

The chapter dealing with practical aspects of chromatography, which comprises about one-third of the book, is extremely useful, however. Workers merely wishing to employ the technique to solve a specific problem will find this chapter a valuable first reference. The book

has adequate references to more than 400 original papers, and although of limited use to the experienced worker in the field, it is recommended as an introduction to the subject to those who only wish to use the technique for a specific problem. R. P. W. SCOTT

COLORIMETRIC METHODS OF ANALYSIS. VOLUME IIIA. F. D. and C. T. Snell. Assisted by C. A. Snell. Pp. x + 576. *Princeton: D. Van Nostrand Co. Inc.; London: D. Van Nostrand Co. Ltd,* 1961. 96*s*.

Of the many books on the various aspects of analytical chemistry published, most, after initial perusal, are relegated to the library shelves where their existence is often soon forgotten. Some few, however, are kept on the analyst's desk and rapidly acquire that well-used appearance which is indicative of their value and importance. 'Snell' is just such a book, which has passed through several editions but has retained its own particular character. It is essentially a well-arranged collection of analytical methods with a minimum of chemistry but sufficient experimental detail to enable any procedure to be applied or adapted. As such it has filled a real need of the professional analyst and of the chemist who has occasion to make analytical determinations.

The present book has a similar scope to that of the earlier Volume III, but includes only material which has been published in the period from 1953 to the beginning of 1960. In so far as is practicable, allowing for the printing delay, this supplement brings up to date the earlier volume, thus following the policy which has already been adopted in the inorganic field. If experience with this may be applied to the present book, it can be recommended not only as an essential adjunct to anyone possessing Volume III, but also to users of other books on photometric analysis who have lacked the time or energy required to keep their own files of working abstracts.

The full title of the book contains the phrase 'including photometric methods,' which justifies the inclusion of a high proportion of procedures in which the optical density is read in the ultra-violet. This is to be commended, not only since these methods are frequently the best available, but also because with modern spectrophotometers the operations involved in carrying out analyses are similar, whether the reading is made in the visible or in the ultra-violet.

Although sub-titled 'Organic Compounds I,' this volume deals not only with organic chemicals and industrial products but also with food, pharmaceuticals, insecticides, fungicides, industrial wastes and atmospheric contaminants. Inevitably, with such a wide scope, some important published procedures have been omitted, but it would be invidious to single any of these out, since most readers will be content with a well-produced volume containing details of more than a thousand procedures culled from an extensive selection of the world's analytical journals.

C. H. R. GENTRY

QUANTITATIVE ORGANIC MICROANALYSIS. Second Edition. A. Steyermark. Pp. xvii + 665. *New York: Academic Press Inc.; London: Academic Press Inc. (London) Ltd,* 1961. 118*s*.

This book is a revised and enlarged version of the first (1951) edition which proved, in its day, to be a very timely and useful reference book. Perhaps this leads one to expect too much from a new edition but, nevertheless, I am disappointed by my overall impression of the present volume. Although microchemistry is definitely one of the most conservative branches of analytical chemistry, the past decade has seen much change and simplification of complicated classical routines, and this progress is, in my opinion, not in evidence in these pages, except in one or two noticeable instances. Consequently, this is a book of very conservative approach in which the time-honoured procedures are reproduced with a few modifications. Great attention is paid throughout the text to the minutest detail of apparatus and dimension (even the minutae of Mariotte bottles), but too little to the scientific background of microchemical reactions. Procedural detail is undoubtedly necessary, but there is little information within these pages for the student eager to understand the basic chemistry of the reactions employed. Topics such as the functioning of catalysts, formation and ageing of halide precipitates, thermal dissociation of carbon dioxide and combustion mechanisms are sadly neglected. It is my contention that an understanding of such basic material is much more likely to be of aid in times of trouble than elaborate instructions of microchemical mystique. Few people are better qualified than the author of this book to deal with such matters.

Despite these observations, it can be said that this book is sound throughout and very reliable, though it employs conditions that are sometimes more rigorous than necessary, *e.g.* a temperature of 1,120° for the main furnace in the oxygen determination (*cf.* Oita & Conway). The use of the simple oxygen-flask decomposition is described only for sulphur, despite the enormous simplification it has introduced into many other ultimate analyses. In extenuation, it may be said that at the end of each chapter there is an up-to-date list of references, but these are classified rather vaguely and in use prove to be of little more value than looking up the abstract press, for they do not even list the title and only indicate the subject matter loosely. The book is well produced, and is profusely illustrated throughout with line diagrams and photographs of commercial apparatus and laboratory 'trains' etc. In summary, this is a good sound book which is in my view, however, rather too conservative in its approach.

T. S. WEST

HANDBOOK OF ORGANOMETALLIC COMPOUNDS. H. C. Kaufman. Pp. iv + 1,546. *Princeton: D. Van Nostrand Co. Inc.; London: D. Van Nostrand Co. Ltd*, 1961. 169*s*.

This vast book is essentially merely a list of organometallic compounds arranged according to the groups in the Periodic Table. It gives the formula name of each compound, its molecular weight, physical characteristics, solubility and a few other physical properties (where these are known) such as refractive index, boiling point, specific gravity or vapour pressure. In addition to compounds with metal-to-carbon bonds, quite a few straight organic compounds are included under carbon and nitrogen, and elements, halides, oxides and other salts also appear. For some, but by no means for all, compounds a reference is given, but this reference does not necessarily apply to the physical properties listed. Many of the references are to the section generally, and without looking them up it is not easy to ascertain to which compound they apply. For several elements I have checked, especially the transition-metal compounds, not only is the coverage far from complete—and nowhere near up to date—but the references are utterly inadequate and a search through the literature for the appropriate references would still be necessary. I would be somewhat hesitant in trusting the figures given here for other than trivial purposes, particularly in view of various errors in names and references. While such a compendium may have limited use in some industrial libraries, better and more complete data books are available for many of the elements, and the very high price of this volume is far from commensurate with its utility. Academically it is valueless.

G. WILKINSON

PUBLICATIONS RECEIVED

ANNUAL REPORT OF THE SCIENTIFIC ADVISER for the year 1960. London County Council Public Health Department—Scientific Branch. Pp. 60. *London: London County Council*, 1961. 1*s*. 3*d*.

REPORT OF THE AGRICULTURAL RESEARCH COUNCIL FOR THE YEAR 1959–60. Pp. 209. *London: H.M.S.O.*, 1961. 9*s*.

REPORT OF THE GOVERNMENT CHEMIST 1960. Pp. iv + 79. *London: H.M.S.O.*, 1961. 5*s*. net.

POISONS AND T.S.A. GUIDE. Sixth Edition, 1960, revised and extended, 1961. Pp. 78. *London: The Pharmaceutical Press*, 1961. 7*s*. 6*d*.

[Pharmacy and Poisons Act, 1933, and Poisons Rules; Transmission of Drugs by Post; Therapeutic Substances Act, 1956; Recommendations by the Pharmaceutical Society; Pharmacy and Medicines Act, 1941; Schedules to the Poisons Rules; Statutes and Regulations; Extended Poisons and T.S.A. List.]

THE BRITISH NATIONAL HEALTH SERVICE. Pp. 22. *London: The Pharmaceutical Press*, 1961. 5*s*.

[Historical; Structure of the Service; Finance of the Service; National Organization of the Service; Local Organization of the Service; Hospital Pharmaceutical Service; Pharmaceutical Services; Investigations of the Health Service; Pharmaceutical Services in Scotland; References.]

THE EXTRA PHARMACOPOEIA. SUPPLEMENT 1961. Pp. xii + 315. *London: The Pharmaceutical Press*, 1961. 32*s*. 6*d*.

REPORTS ON PROGRESS IN PHYSICS. VOLUME XXIV. Edited by A. C. Stickland. Pp. 424. *London: The Institute of Physics and The Physical Society*, 1961. [Includes articles on the theory of the superconductive state; high-current gas discharges; cosmic radio waves and their interpretation; magnetic domains; photoelectronic image intensifiers; ferrimagnetism; theory and applications of the density matrix; the dynamics of high-temperature plasmas.]

MODERN CHEMICAL PROCESSES. VOLUME VI. By the Editors of *Industrial and Engineering Chemistry*. Pp. 126. *New York: Reinhold Publishing Corporation; London: Chapman & Hall Ltd*, 1961. 48*s*.

[Contents : manufacture of basic silicone products; chemicals from wood; derivatives of acrolein and peracetic acid; pentaerythritol; fluidized bed roasting ovens; grignards for commerce; detergents continuously; design and construction of a phosphate insecticides plant; catalyst manufacture; partially acetylated (PA) cotton; silica–alumina petroleum cracking catalyst; specialty surfactants; glycols and ethanolamines; 2,4-D weed killer and derivatives; acrylates and methacrylates; chemicals from acetaldehyde.]

MATERIALS FOR GAS CHROMATOGRAPHY. Second Edition. (Standards and Data for 'Embaphase' Stationary Phases and 'Embacel' Kieselguhr.) Pp. 51 + 12 Data Sheets and 2 Appendixes. *Dagenham: May & Baker Ltd*, 1961.

BRITISH STANDARDS

526 : 1961. Definitions of the Calorific Value of Fuels. Pp. 20. 6*s*.

33979 : 1961. Methods of Testing Synthetic Rubber Latices. Pp. 9. 4*s*.

1647 : 1961. Specification for pH Scale. Pp. 13. 4*s*. 6*d*.

903 : Part A21 : 1961. Methods of Testing Vulcanized Rubber. Determination of Rubber-to-Metal Bond Strength. Pp. 11. 3*s*.

Institute Affairs

ANNUAL CONFERENCE, LONDON
12–13 April, 1962

The 1962 Annual Conference of the Institute will be held in London on Thursday and Friday, 12 and 13 April. It has been decided that, on this occasion, the Conference should extend over two days only, instead of the customary three days, but the Programme of Events that is now being prepared is similar in general form to those of recent years, and will include features that are likely to be of exceptional interest to many members and their guests.

On Thursday, 12 April, Sir William Slater, K.B.E., F.R.S., will give his Presidential Address at the opening of an all-day Symposium on Chemistry in the Service of Agriculture. The Annual Dinner will be held at the Dorchester Hotel on the evening of the same day.

The Annual General Meeting will be held in the morning of Friday, 13 April, at the School of Pharmacy, Brunswick Square, W.C.1, which will also be the venue for other business meetings. In the evening the directors of the Shell Refining Co. Ltd, in association with the Shell Chemical Co. Ltd and Shell Research Ltd, have generously offered to provide a reception at Claridge's Hotel.

Copies of the Programme of Events and Registration Forms will be sent, with information about hostel accommodation, to all corporate members in Great Britain and Ireland in January, 1962.

EXAMINATIONS, FEBRUARY, 1962

Diplomas in Applied Chemistry: Branches A, D and E.—Examinations will be held in the week beginning **Monday, 12 February, 1962,** in London. The last date for the receipt of entries is **Monday, 4 December, 1961**.

EXAMINATIONS, APRIL, 1962

Graduate Membership, Part II

The theoretical section of the examination, Part II (*a*), will be held in London and Newcastle upon Tyne and, if required, in other centres on **Monday and Tuesday, 2 and 3 April, 1962.**

Practical exercises will be carried out in London and in Newcastle upon Tyne on **Wednesday to Saturday, 4 to 7 April,** inclusive, and in London on **Tuesday to Friday, 10 to 13 April,** inclusive.

Candidates will be asked to state their preference as to the centre for their theoretical papers and the period and centre for their practical exercises, but it must be clearly understood that no guarantee can be given that their wishes will be met.

Candidates who have not yet been accepted for examination and who wish to present themselves in April should obtain from the Assistant Registrar without delay the prescribed Application Form, so as to allow ample time for obtaining the necessary signatures certifying that they have complied with the Regulations concerning their courses of training. **The completed Application Forms must reach the Institute not later than Wednesday, 3 January.** No application will be considered if received after that date.

The last date for the receipt of Entry Forms is Monday, 5 February. No Entry will be accepted if received after that date.

EXAMINATIONS, SEPTEMBER, 1961

Graduate Membership, Part II

Examiners: Professor W. G. Overend, Dr A. G. Sharpe, Professor W. F. K. Wynne-Jones

Assistant Examiners: Dr G. W. H. Cheeseman, Dr D. A. Frye, Dr A. D. Mitchell

The examination was held at the Universities of Birmingham and London and at the Royal College of Science and Technology, Glasgow, the theoretical papers being taken also at various local centres in the periods 11–16 September and 19–22 September, 1961.

The total number of candidates was 168, of whom 41 passed (24·4 per cent).

Of the 168 candidates taking Part II, six studied full-time, of whom two passed; 15 attended 'sandwich' courses, of whom five passed; 58 attended part-time courses preceded or followed by a period of full-time or 'sandwich' study, of whom 19 passed; 89 trained wholly by means of part-time courses, of whom 15 passed. Of all the candidates, 83 had previously passed Part I, of whom 29 passed Part II (35 per cent); 33 had been exempted from Part I under Regulation F3, of whom eight passed Part II (24 per cent); 11 had been exempted from Part I under Regulation F4, of whom one passed Part II; 41 were deemed to have been exempted from Part I under the transitional arrangements, of whom three passed Part II (7 per cent).

Pass List

Allen, Malcolm George, Central College of Further Education, Carlett Park, Eastham (Wirral)

Allsop, John Cecil, Wolverhampton and Staffordshire College of Technology, Wolverhampton

Atkinson, Geoffrey, Constantine Technical College, Middlesbrough; Rutherford College of Technology, Newcastle upon Tyne

Baker, Paul James, Northampton College of Advanced Technology, London; Sir John Cass College, London

Bays, David Edmund, Norwood Technical College, London; Sir John Cass College, London

Berry, Edwin Enfield, Battersea College of Technology, London; Brunel College of Technology, London

BEVAN, Geoffrey, Central College of Further Education, Carlett Park, Eastham (Wirral)
BROWN, Miss Valerie, Constantine Technical College, Middlesbrough
CHRISTIAN, John Roland, Technical College, Bolton
COTTON, John William, Borough Polytechnic, London; Chelsea College of Science and Technology, London
DEALTRY, Christopher Edward, Institute of Technology, Bradford
DUMBRECK, Adam Charles, Technical College, Paisley
HESLAM, Robin Snell, Technical College, Birkenhead; Central College of Further Education, Carlett Park, Eastham (Wirral)
HILLS, Ian Richard, Medway College of Technology, Chatham
HOPKINSON, John Walter, Institute of Technology, Bradford; Royal College of Advanced Technology, Salford
HUGHES, Ernest John, Central College of Further Education, Carlett Park, Eastham (Wirral)
JACKSON, Brian Malcolm Banks, Medway College of Technology, Chatham; University of Exeter
JOHNSON, Peter, Northern Polytechnic, London
JONES, Edward Owen, Central College of Further Education, Carlett Park, Eastham (Wirral)
KILLOH, David Charles, Brunel College of Technology, London
LUFF, Norman Albert Julius, College of Further Education, Slough
LYNES, Albert, Central College of Further Education, Carlett Park, Eastham (Wirral)
MCINTOSH, Brian Dudley, Technical College, Kingston (Surrey); Battersea College of Technology, London
MILLS, Richard John, Medway College of Technology, Chatham
MONAHAN, James, Woolwich Polytechnic, London; College of Technology, Oxford
MOORE, Frank Eric, Nottingham and District Technical College, Nottingham
NICOLSON, Norman Derek, S.W. Essex Technical College, Walthamstow
OXLEY, Charles Edward, College of Further Education, Widnes
PATTISON, William Arthur, Central College of Further Education, Carlett Park, Eastham (Wirral)
PHILP, John, Technical College, Paisley
PODMORE, John, College of Technology, Liverpool
RIXSON, Alan Gerald, Woolwich Polytechnic, London
SCOTLAND, William West Frederick, Woolwich Polytechnic, London
SHADBOLT, Roy Stanley, College of Technology, Hatfield; Sir John Cass College, London
SKUJINS, Sigurds, Woolwich Polytechnic, London
SMITH, Keith Martin, College of Advanced Technology, Birmingham; Wolverhampton and Staffordshire College of Technology, Wolverhampton
SPERRIN, Alan David, Battersea College of Technology, London
TIVNANN, Richard Fife, Central College of Further Education, Carlett Park, Eastham (Wirral)
TUNNELL, David Alan, B.Sc. (Lond.), Technical College, Gloucester; University College, London
WILLIAMS, Peter, College of Technology, Leeds
WRIGHT, Henry Glyn, Constantine Technical College, Middlesbrough

THE TEACHING OF INORGANIC CHEMISTRY

A one-day symposium on the teaching of inorganic chemistry at pre-university level will be held in the Institute of Education, University of Southampton, on 24 March, 1962. The symposium is being organized by the Mid-Southern Counties Section of the Institute in collaboration with the Southern Counties Branch of the Science Master's Association.

The speakers will include Professor C. C. Addison (University of Nottingham), Dr G. W. A. Fowles (University of Southampton), Mr H. R. Jones (Carlett Park Central College of Further Education) and Dr J. E. Spice (Winchester College).

Application forms will be distributed shortly to members of the Institute in the Mid-Southern Counties Section and neighbouring areas, and to chemistry masters and mistresses in schools within reasonable travelling distance of Southampton. The registration fee for the symposium is 10*s*.

SUMMER SCHOOL IN ANALYTICAL CHEMISTRY 1962

The fifth Summer School in Analytical Chemistry will be held at the Manchester College of Science and Technology from 9 to 15 September, 1962.

The School will consist of four separate but concurrent courses :

COURSE I

Physical Methods of Organic Chemistry

Course Organizer : Dr D. W. Mathieson, *Fellow*, Reader in Pharmaceutical Chemistry, School of Pharmacy, University of London

Section A : *Infra-red spectroscopy*—A one-week intensive course on structure/spectra relationships in organic molecules. Lectures and seminars will be held on the interpretation of spectra. A wide range of recent instruments will be available.

Section B : An omnibus section comprising *nuclear magnetic resonance*, *mass spectrometry* and *spectropolarimetry*. Lectures and seminars will be held on the basic theory of these topics and the applications of the techniques in organic chemistry. Demonstrations and practical work will be carried out on the latest instruments.

COURSE II

Recent Developments in Inorganic Analysis

Course Organizer: Mr W. T. Elwell, *Fellow*, Chief Analyst, Imperial Chemical Industries Ltd, Metals Division, Witton

Lectures and practical work will cover the following topics: atomic absorption spectrophotometry; solid-source mass spectrometry; electrometric titrimetry; complexometric titrations; X-ray fluorescence; analysis for the 'newer' metals; solvent extraction; ion exchange; trace inorganic constituents in soils; applications of modern analytical methods in ceramics; new physico-chemical techniques in iron and steel analysis. Some of the lectures will be held jointly with Course IV.

COURSE III

The Determination of Toxic Substances in the Air and in Effluents

Course Organizer: Mr H. E. Stagg, *Fellow*, Chief Analyst, Imperial Chemical Industries Ltd, Dyestuffs Division, Blackley

An essentially practical course on the sampling of gases and vapours and their determination by titrimetric, absorptiometric, test paper, indicator tube and instrumental methods; the sampling and analysis of dusts; detection and assessment of hazards due to radioactive materials; the control of aqueous effluents.

COURSE IV

Newer Instrumental Methods

Course Organizer: Dr V. S. Griffiths, *Fellow*, Reader in Spectroscopy, Battersea College of Technology

Lectures will take place on atomic absorption spectrophotometry; electrometric titrimetry; solid-source mass spectrometry; X-ray fluorescence; paramagnetic resonance of inorganic compounds; scattering spectrophotometry of emulsions; flame photometry; ultrasonic techniques; infra-red techniques in inorganic chemistry; thermogravimetric analysis. Some of the lectures will be held jointly with Course II.

The practical sections will provide an opportunity to use the latest instrumental methods for visible and U.V. spectroscopy; electrochemical determinations; flame photometry; fluorescence (electron spin resonance); and automatic techniques in analysis.

Course I is expected to appeal mainly to organic chemists in universities, higher technological institutions, research organizations and research departments of industrial firms—in the U.K. and overseas—but it will also be of interest to analytical chemists who use modern instrumental methods of organic analysis. It is believed that this will be the first occasion that an intensive residential postgraduate course of this nature has been organized in this country or in Europe.

Courses II and IV will be of general interest to analytical chemists in industry and to inorganic and physical chemists in academic or research institutions who wish to develop or apply the latest techniques of analysis. Course II is concerned with the applications of these techniques to inorganic analysis; Course IV will provide a general survey of recent instrumental methods.

Course III is expected to appeal to those analytical chemists in industry, and others, whose special concern is the detection and determination of toxic substances, including radioactive waste, in the air and in effluents.

Further details and registration forms will be circulated to all members of the Institute and to members of the Society for Analytical Chemistry in **January, 1962**. The Summer School will be open to any qualified chemist in the U.K. or overseas, but a large proportion of the places will be reserved, up to 1 March, 1962, for members of the R.I.C. or the S.A.C. Residential accommodation will be available. Publicity leaflets are already being distributed to universities, technical colleges, research institutions and many industrial firms. Additional copies may be obtained from the Institute, at 30 Russell Square, London, W.C.1.

Conference of Honorary Representatives.—A new step in collaboration between the Institute and the universities was taken on 28 September when the Institute's Honorary Representatives met for a Conference at 30 Russell Square, London. The President, Sir William Slater, K.B.E., F.R.S., was in the Chair. Four Vice-Presidents, Professor H. J. Emeléus, C.B.E., F.R.S., Mr E. Le Q. Herbert, Dr G. R. Ramage and Mr E. J. Vaughan, the members of an *ad hoc* Committee on Relations with Universities and University Graduates, and the Administrative Officers also attended. The Conference provided an opportunity for advising on drafts of a proposed poster for display in universities and a brochure for issue to university students and graduates. There was also a useful exchange of views on university relations with the Institute and the changing pattern of chemical education in universities and schools. It was generally agreed that the meeting provided a valuable opportunity for discussing matters of mutual interest and it was suggested that similar conferences should be held from time to time.

The members attending the Conference were entertained to luncheon by Mr E. Le Q. Herbert, *Immediate Past-President*, at Shell-Mex House.

Institute Representatives.—The Council has nominated the following to represent the Institute on committees:

Corby Technical College: Governing Body: Mr J. Glen, *Associate*.

University of Liverpool: The Court of the University: Mr P. N. Williams, *Fellow*.

Portsmouth College of Technology: Chemical Industries Advisory Committee: Mr L. A. Shearing, *Fellow*, in succession to Dr G. T. Ball.

Liaison Officers.—The following changes of Liaison Officers in Technical Colleges have been made:

Doncaster Technical College: Mr I. B. Stuart, *Fellow*, Senior Lecturer in Chemistry, in succession to Mr W. F. Andrews, who has retired.

Cambridgeshire Technical College: Dr G. E. Little, Senior Lecturer in Chemistry, in succession to Mr P. S. Jewell, who has retired.

Coatbridge Technical College: Mr S. Kawa, *Associate*, as acting Liaison Officer on the appointment of Dr J. Stark as H.M. Inspector.

Honorary Representatives.—The following changes of Honorary Representatives in Universities have been made:

University of Liverpool: Dr H. W. Douglas, *Fellow*, in succession to Dr A. Hickling.

King's College, Newcastle upon Tyne: Professor W. F. K. Wynne-Jones, *Fellow*, in succession to the late Mr R. F. Dodd.

Recognition of Colleges.—Ewell County Technical College has been granted provisional recognition for the training of students to the Part I level of the Graduate Membership examination.

A Chemist's Introduction to Statistics: Errata.—We regret that some errors crept into Lecture Series 1961, No. 2, by Dr D. A. Pantony, after the author had passed the proofs.

Page 6. Equation (4) should read $S = \frac{s}{\bar{x}}$

Page 7. Equation (5) should read

$$y = \frac{h}{\sqrt{\pi}} \exp\,[-h^2\,(X-\mu)^2]$$

Page 12. Equation (8) should read

$$\sigma_{\bar{x}} = \sqrt{\left(\frac{1}{N}\right)^2 \cdot N\sigma_{x_N}^2}$$

Page 16. Paragraph 3, line 3. *For* 0·9 per cent *read* 0·19 per cent.

Page 19. Delete '(10)' after the term $\frac{\Sigma\delta x.\delta y}{N\sigma_x\sigma_y}$

Page 23. Last equation, last term should read σ_y^2.

Errata.—In *J.*, 307, the note about Mr K. W. Allen should read 'University of *Pittsburgh*, Pennsylvania.'

In *J.*, 341, Dr J. P. Elder is incorrectly referred to as Mr J. P. Elder.

PERSONAL NOTES

Honours and Awards

Dr J. W. Clark-Lewis, *Fellow*, reader in organic chemistry, University of Adelaide, has been awarded the degree of D.Sc. by the University of London for his work in the field of organic chemistry.

Professor E. R. H. Jones, F.R.S., *Fellow*, *Meldola Medallist*, Waynflete Professor of Organic Chemistry in the University of Oxford, has been selected by the American Chemical Society to receive the 1962 Fritzsche Award for his work in the field of terpenoid chemistry, notably the chemistry of the higher terpenes and the synthesis of terpenoids related to vitamin A. He has also been appointed a member of the Council for Scientific and Industrial Research.

Professor C. Kemball, *Fellow*, *Meldola Medallist*, Professor of Physical and Inorganic Chemistry, Queen's University, Belfast, has been awarded the Ipatieff Prize of the American Chemical Society for 1962. This prize, named after Vladimir Nikolaevich Ipatieff (1867–1952), consisting of a diploma and $3,000, is awarded every three years; though there have been six awards so far, this is the first time it has gone to a non-American chemist. The purpose of the prize is to recognize outstanding chemical experimental work in the field of catalysis or high pressure, carried out by men or women of any nationality and not over 40 years of age.

University of Toulouse.—Professor K. G. Denbigh, F.R.S.E., *Fellow*, and Professor D. M. Newitt, M.C., F.R.S., *Fellow*, were awarded Honorary Doctorates by the University of Toulouse on 27 September.

Societies and Institutions

Mr J. Blair, *Fellow*, was elected Renter Warden of the Worshipful Company of Dyers for the ensuing year at a General Court of the Company held on 11 October.

Mr J. C. Hanbury, *Fellow*, succeeded Sir William Garrett as chairman of the Association of British Chemical Manufacturers at the Annual General Meeting of the Association on 12 October. He has also been elected chairman of the British Pharmaceutical Conference for 1961–62.

Mr B. Hickson, *Fellow*, who was chairman of the Association of British Chemical Manufacturers in 1957–59, has been elected President of the Council of the Association for 1961–62.

Professor R. J. W. Le Fèvre, F.R.S., *Fellow*, has been elected President of the Royal Society of New South Wales for 1961–62.

Professor T. S. Wheeler, *Fellow*, recently visited scientific institutions and research centres in Hungary as the guest of the Hungarian Academy of Science. He lectured at the Annual Meeting of the Hungarian Chemical Society in Debrecen, and at the Academy Stereochemical Centre in Budapest.

Dr J. F. Wilkinson, *Fellow*, was elected President of the European Haematological Society for 10 years at a meeting of the Haematological Congress held in Vienna recently. He was elected Vice-President (Eastern Hemisphere) of the International Haematological Society for a similar period in Tokyo last year.

Association of Clinical Biochemists.—At the recent Annual General Meeting of the Association the following *Fellows* were elected as officers: President, Dr A. L. Latner; Chairman, Mr H. Varley; Hon. Treasurer, Dr R. Gaddie; and Hon. Secretary, Dr J. H. Wilkinson.

Educational

Dr B. R. Agarwal, *Fellow*, reader in chemistry, University of Roorkee, India, is at present at the Kedzie Chemical Laboratory, Michigan State University. He expects to stay in the U.S.A. for two years.

Mr D. J. Alsop, *Associate*, has left this country to take up a postdoctoral research fellowship at Ohio State University, Columbus, U.S.A.

Mr E. N. Annable, *Associate*, has been appointed senior science master, Kenilworth Grammar School.

Mr W. R. H. Batty, *Associate*, has resigned his position of assistant secretary to the University of Birmingham Appointments Board to take up the post of lecturer and tutor to the University chemistry department.

Dr C. J. Brown, *Fellow*, formerly research scientist, Imperial Chemical Industries Ltd, Dyestuffs Division, has been appointed Research Associate, department of chemistry, University College, London.

Dr A. F. Casy, *Fellow*, principal lecturer in pharmaceutical chemistry, Chelsea College of Science and Technology, will be at the school of pharmacy, University of Wisconsin, Madison, U.S.A., until September, 1962.

Dr R. G. Davies, *Associate*, formerly senior geologist, Hunting Technical Services Ltd, is now Leverhulme Professor, department of geology, University of the Panjab, Lahore, West Pakistan.

Dr P. F. Duggan, *Associate*, has returned from the U.S.A., where he was at the National Institutes of Health, Bethesda, to the biochemistry department, University College, Dublin.

Dr C. Eaborn, *Fellow*, reader in physical-organic chemistry, University of Leicester, has been appointed Professor of Chemistry, University of Sussex.

Dr R. A. W. Green, *Fellow*, formerly senior lecturer in inorganic chemistry, University of Sydney, has been appointed Associate Professor of Inorganic Chemistry.

Professor E. D. Hughes, F.R.S., *Fellow*, *Meldola Medallist*, Professor of Chemistry, University College, London, has been appointed head of the department of chemistry at the College, as from 1 October.

Mr D. L. Inkpin, *Associate*, has resigned his post with Glaxo Laboratories Ltd to take up a teaching post at the Westcliff High School for Boys.

Mr P. K. Khopkar, *Associate*, of the Atomic Energy Establishment (Trombay), Bombay, India, will, for the next year, be training in the department of structural and inorganic chemistry, University of Leeds, under the Colombo Plan.

Mr R. K. Kochhar, *Associate*, is at present at the department of chemistry, University of Texas, Austin, U.S.A., to undertake higher studies in chemistry; he expects to remain there for three years.

Mr D. F. Larder, *Graduate Member*, formerly a teaching assistant in the department of chemistry, University of Alberta, Canada, has been appointed professor of chemistry, Notre Dame University College, Nelson, British Columbia.

Dr U. K. Pandit, *Associate*, is now at the Laboratorium Voor Organische Scheikunde, University of Amsterdam, The Netherlands.

Mr M. H. Pay, *Associate*, of the University of Cape Town, is expected to be in the U.K. until December.

Mr R. S. Roche, *Associate*, has resigned his post of Scientific Officer, chemistry division, Dounreay Experimental Reactor Establishment, U.K.A.E.A., and is now B.X. Plastics Research Scholar at the University of Glasgow.

Dr J. Stark, *Associate*, formerly head of the chemistry department, Coatbridge Technical College, is now an H.M. Inspector of Schools.

Dr D. H. Treble, *Associate*, has left this country for the U.S.A., where he will be at the department of biological chemistry, Harvard Medical School, Boston, Mass.

Dr G. C. Wood, *Associate*, has left the department of metallurgy at the University of Cambridge to take up a lectureship in chemical engineering (corrosion science) in the faculty of technology, University of Manchester.

Public and Industrial

Mr D. Balmforth, *Associate*, has left the department of colour chemistry and dyeing, University of Leeds, to join Courtaulds Ltd, Spondon, Derby.

Dr A. E. Bender, *Fellow*, has resigned his post of head of the research department, Bovril Ltd, to take up an appointment as head of the newly-established research and development department, Farley's Infant Food Ltd.

Mr D. A. Benfield, *Associate*, has taken up an appointment in Toronto in the sales division of the chemical products department, Imperial Oil Ltd.

Mr J. Bernstein, *Associate*, has resigned from the Simplex Electric Co. Ltd after nearly 12 years with that company, the last nine as works and foundry manager. He has been appointed works director, London Aluminium Co. Ltd.

Dr W. Blakey, *Associate*, has been appointed chairman of B.I.P. Chemicals Ltd, a subsidiary of British Industrial Plastics Ltd.

Mr V. M. Bond, *Associate*, has been appointed finance controller and secretary of Nicholas Laboratories Ltd.

Mr A. C. H. Cairns, *Associate*, formerly managing director, Unilever Export Ltd, has been appointed chairman of that company.

Mr P. Cleevely, *Associate*, formerly an analyst with the United Chemists Association Ltd, is now senior analyst, Nicholas Products Ltd.

Mr M. P. Coward, *Associate*, has resigned his appointment as research assistant, Procter department of food and leather science, University of Leeds, to take up a position as research chemist, Unilever Ltd, Port Sunlight.

Mr H. M. Davies, *Associate*, has returned to this country from Canada, and is now with Monsanto Chemicals Ltd, Newport.

Dr W. H. T. Davison, *Fellow*, has been appointed assistant director, Tube Investments Research Laboratories; he retains his post as head of the chemistry section.

Sir John Dean, *Associate*, has retired from the board of British Insulated Callender's Cables Ltd and certain subsidiaries to devote his time to the chairmanship of Submarine Cables Ltd, in which B.I.C.C. has a 50 per cent interest.

Dr E. J. Dickinson, *Fellow*, has joined Burt, Boulton & Haywood Ltd, and will be responsible, jointly with Mr D. H. Spranklin, *Associate*, for group development and research in the tar distillation and chemical fields.

Mr W. H. Dyson, *Fellow*, has been appointed managing director of Tororo Industrial Chemicals and Fertilizers, a subsidiary company of the Uganda Development Corporation.

Mr B. R. Edmondson, *Associate*, has been appointed sewage works manager to the County Borough of Walsall.

Mr W. A. M. Edwards, *Fellow*, has been appointed a visiting director, Imperial Chemical Industries Ltd, Heavy Organic Chemicals Division.

Mr M. H. Farmer, *Associate*, has joined the Standard Oil Company (N.J.) as new uses adviser. He was formerly with the Esso Research and Engineering Co.

Dr R. L. Forman, *Associate*, has left the Medway College of Technology to join the technical service department of Imperial Chemical Industries Ltd, General Chemicals Division, Liverpool.

Dr H. M. Glass, *Fellow*, has been appointed technical director of the British Standards Institution.

Mr A. J. Goodall, *Fellow*, has been appointed general production manager, Batchelors Foods Ltd.

Dr D. E. Hathway, *Fellow*, has been appointed head of the division of biochemistry, Tunstall Laboratory (Toxicology), Shell Research Ltd. He was formerly with the British Leather Manufacturers' Research Association.

Dr B. H. Howard, *Fellow*, Principal Scientific Officer, Rowett Research Institute, Bucksburn, Aberdeenshire, has been awarded a 1961 senior research fellowship by the New Zealand D.S.I.R.

Mr J. Jackman, *Associate*, has joined Lankro Chemicals Ltd as general manager, leather auxiliaries department.

Sir Harry Jephcott, *Past President*, has retired as chairman of the Council for Scientific and Industrial Research, having completed his five-year term of office. The present chairman is Sir Harold Roxbee Cox.

Mr J. T. G. Johnson, *Fellow*, has been appointed quality adviser to the board of Whitbread & Co. Ltd, as from 1 October. He will operate from the Brewery, Chiswell Street, London, E.C.1.

Mr A. W. Jubb, *Associate*, has resigned his post as section leader, central research laboratories, Associated Chemical Companies Ltd, and taken up an appointment with Bardens (Bury) Ltd as chief chemist.

Mr J. F. King, *Fellow*, has been appointed a director of the Morgan Crucible Co. Ltd. He is managing director of Morgan Refractories Ltd, a subsidiary.

Dr G. Landells, *Associate*, has been appointed chief chemist at the central laboratories of the Bradford Dyers' Association Ltd.

Mr B. L. Levinson, *Associate*, has been appointed technical superintendent, British Hydrocarbon Chemicals Ltd, Baglan Bay. He was formerly deputy technical superintendent at Grangemouth.

Dr M. F. Lynch, *Associate*, has recently resigned his post with Ciba (ARL) Ltd to take up a position in the research division of the Chemical Abstracts Service, Ohio State University, Columbus, U.S.A.

Dr J. R. Nicholls, C.B.E., *Fellow*, is to attend the Twelfth Session of the World Health Organization's Expert Committee on Addiction-Producing Drugs at Geneva later this month. He has been a member of this Committee since it was formed in 1949.

Dr S. Orman, *Associate*, formerly a research associate at Brandeis University, Waltham, Mass., U.S.A., is now with the chemistry research division, Atomic Weapons Research Establishment, Aldermaston.

Dr J. E. Priddle, *Associate*, formerly of the department of organic chemistry, University of Bristol, has recently joined the research department, Imperial Chemical Industries Ltd, Welwyn Garden City.

Mr M. H. Procter, *Associate*, has left this country for New Zealand, where he has taken up an appointment as Scientific Officer, D.S.I.R., plant chemistry division.

Dr C. Rainbow, *Fellow*, formerly senior lecturer in charge of malting and brewing, department of biochemistry, University of Birmingham, has been appointed chief chemist, Bass, Ratcliff & Gretton Ltd.

Mr I. L. Slatopolsky, *Associate*, formerly works manager of the Ely sugar factory, British Sugar Corporation Ltd, has been appointed general manager of the Corporation's beet sugar factory at Spalding.

Mr J. M. Sturton, *Associate*, formerly senior analyst, laboratory and metal finishing division, Westinghouse Brake & Signal Co. Ltd, has taken up an appointment in the research department, Imperial Chemical Industries Ltd, Metals Division, Birmingham.

Dr M. G. S. Suryaraman, *Associate*, formerly Dow Chemical Co. research fellow, University of Colorado, has been awarded the Ph.D. degree of that University and has joined the Monsanto Chemical Co., St Louis, Missouri, as an analytical research chemist.

Mr H. Warne, *Fellow*, has been appointed technical adviser to the board of the Bush Beach and Segner Bayley Group, as from 1 October.

Mr H. Warson, *Fellow*, formerly research manager, Vinyl Products Ltd, has been appointed development manager (polymers), Dunlop Chemical Products Division, Birmingham.

FORTY-FIFTH CONFERENCE OF LOCAL SECTION HONORARY SECRETARIES

The Forty-fifth Conference was held in the Council Room, Royal Institute of Chemistry, London, at 10 a.m. on Saturday, 21 October, the Chair being taken by the President, Sir William Slater. Professor Harold Burton (Hon. Treasurer; Chairman of the Finance and House and Benevolent Fund Committees), Mr E. J. Vaughan (Vice-President; Chairman of the Membership Committee) and Mr G. Dring (Vice-President; representing the Publications Committee) were present, and the Administrative Officers were in attendance. All but four Local Sections were represented by their Hon. Secretaries. Cardiff and District was represented by Mr S. J. H. O. Chard, Member of Committee, in place of Mr R. C. F. Stephens; Leeds Area by Dr R. L. Elliott, District Member of Council, in place of Mr W. A. Wightman; Sheffield, South Yorkshire and North Midlands by Mr G. Robinson, Chairman, in place of Mr C. Walker.

Support for Educational Meetings. The Liverpool and North-Western Section, having in mind the considerable interest in educational matters now in evidence in many parts of the country, asked to what extent the Institute Fund for the Development of Education in Chemistry could be called upon to support conferences and symposia organized by Sections to meet local demands, including events arranged primarily for teachers—whether members or not. There was unanimous agreement that such meetings had an important function and that they should be encouraged. But it would be difficult to generalize on the way such meetings should be financed. Advance notice of several such conferences had been received by the Trust Fund in the past year or so, and help had been given to the extent of meeting deficits. On the other hand, when such meetings could be regarded as a normal and useful development of Local Section activities, there was no reason why Section funds should not be spent on them. The Hon. Treasurer reminded the Sections that as these were legitimate expenses, any Section running into difficulties could apply for a supplementary grant. Every effort should be made to arouse the interest of teachers at all levels in the important educational developments now taking place, and the Institute, being concerned with all levels of the educational ladder, had a most important part to play in fostering improved teaching methods. It was most gratifying to the Council that a steady flow of grammar-school teachers were now applying for membership.

Relations with Universities and Technical Colleges. This was one of the topics raised at the Conference of Hon. Representatives of the Institute in universities, at the first such conference held on 28 September (p. 410). Conditions varied greatly in the different areas; in some, one or several universities dominated the educational scene and the staff was active in Institute affairs, whereas in some others close relations existed with one or several technical colleges. On the other hand there seemed no reason for introducing any standard procedure, *e.g.* by co-opting Liaison Officers or Hon. Representatives to Section Committees. Indeed, in some areas this would be impracticable. It was important that each Section should see that no educational sector was overlooked, and one way of ensuring this was to arrange meetings jointly with college or university student chemical societies. The need for more publicity material was realized, and a poster for display in universities and a brochure on 'The Royal Institute of Chemistry and the Universities' were in preparation. The part that could be played by the Officers of Local Sections in ensuring personal and continuing contact with educational institutions was also discussed.

Courses for Licentiateship. The Conference deplored the tendency of some colleges to take it for granted that recent developments in connection with the proposed Licentiateship grade justified notifying students that courses for that grade were now in being. Apart from the fact that the grade did not yet exist, and could not exist without the approval of the revised By-laws by the Privy Council, it could not be taken for granted that any such course would in fact admit a student to that grade until relevant regulations had been promulgated and particular courses approved. It was suggested that promising students who obtained the H.N.C. would at present be best advised to proceed to Part I Grad.R.I.C. If at a later stage they wished to go on to Part II they would be in a better position than if they had obtained an endorsement on a H.N.C. after completing a special course for Licentiateship; in the latter event they might have to take a further course for Part I Grad.R.I.C. before going forward to Part II. All students who appeared capable of reaching Part I standard should therefore be advised to do so, in order to remain on the direct route towards a professional qualification. It was noted that, if a Licentiate subsequently qualified for Graduate Membership, he would not be transferred from the corporate to the non-corporate grade but would be expected to wait until

he had acquired the necessary additional experience that would render him eligible to proceed directly to the Associateship.

Status of Licentiates in Local Sections. At the request of the Liverpool and North-Western Section, views were expressed as to the part Licentiates might be expected to play in the affairs of Local Sections. It was recognized that Licentiates, as corporate members, would be eligible for election to Section Committees or to occupy any position that met with the approval of the other corporate members.

Common Objects of Local Sections. The agreed statement of common objects, printed as an appendix to the Charter and By-laws (1955), is reprinted for information in the Section Rules booklets of most Local Sections. This statement is necessarily subject to revision with changing conditions, and the next suitable occasion would arise when the proposed Licentiateship grade was introduced. Hon. Secretaries agreed to study the statement and to forward suggestions for modification.

Subjects for Lectures. The Tees-side Section asked for information about surveys that had been carried out to learn what kinds of meetings and topics for lectures were most acceptable to the majority of members. It transpired that several Sections had attempted to ascertain the wishes of their members in this way, but in general the response had been poor. Most Local Sections had found that the majority of members preferred a talk by a well-known lecturer, but few were interested in highly academic themes. Second in interest were lectures on industrial and general chemical topics. In some areas meetings for the reading of short papers by several local members were proving popular. Academic lectures came at the bottom of most Sections' lists. This was not altogether surprising as, apart from the considerable number of members in nearly all Sections who were unable to travel very frequently to the centres where meetings were held, many of them had quite enough to do with their professional subject during their working hours, or lived in an area where there was already a surfeit of meetings and lectures on advanced topics, few of which could be expected to interest more than a few members.

Current Developments in Education. The Education Officer outlined the current developments in chemical education that were receiving attention in this country and overseas. In these developments the Institute could have an important part to play, particularly as a co-ordinator of various activities. The most urgent task, however, is to assist the Science Masters' Association and the Association of Women Science Teachers in their efforts to introduce new syllabuses in school chemistry through the Examining Boards and to provide extensive guidance on the interpretation of such syllabuses for teachers in schools and technical colleges. This aspect, it was suggested, would involve co-operation and goodwill from the universities and the Ministry of Education, especially in the provision and organization of refresher courses on a large scale. The view was expressed that Local Sections could assist in the organization of any refresher courses that might be arranged in their areas. The importance of effective co-ordination was stressed, and the possibility of establishing a British National Committee for Chemical Education for this purpose was mentioned.

Institute Publications. Attention was drawn particularly to the growing series of 'Monographs for Teachers'. These had been very well received in this country, and interest was now being shown in this venture by educational bodies in the U.S.A. The assistance of the Local Sections was asked in making them known as widely as possible on suitable occasions.

Recent additions to the series were *Principles of Metallic Corrosion*, by Dr J. P. Chilton, and *Principles of Chemical Equilibrium*, by Dr P. G. Ashmore. Both of these dealt with difficult topics in a particularly illuminating manner. The next Monograph in the series would be *Principles of Titrimetric Analysis*, by Dr E. E. Aynsley and Mr A. B. Littlewood, whose approach to the subject would be both modern and balanced. It was expected that this would be ready in January next.

A new edition of the *Directory of Independent Consultants* in Chemistry and related subjects was now available and was being widely distributed.

The new-style Lecture Series had been generally approved by members. The first three items were specially written for the occasion, but Nos 4, 5 and 6 would be typical lectures, viz. Mr R. C. Chirnside, *Ramsay, Chemistry and the Electrical Industry*; Dr J. W. Cook, F.R.S., *Tobacco Smoke and Lung Cancer* (Fourth Henderson Memorial Lecture); and Dr J. I. G. Cadogan, *Recent Developments in the Chemistry of Free-Radical Addition Reactions* (Meldola Medal Lecture). Sections were reminded that the Publications Committee welcomed their suggestions of titles for inclusion, and would carefully consider recommendations for the printing of lectures of general interest and special merit.

A number of difficulties had arisen in reconciling postal addresses and Section boundaries in the new *Geographical Index* to the *Register*, and a number of both genuine and apparent errors had been pointed out. Sections are asked to report any such inconsistencies to the office of the Institute so that the questions can be examined before any future *Index* is put into production.

As the meeting came to a close, Mr T. F. McCombie (Mid-Southern Counties Section) thanked the President for his genial and efficient handling of the proceedings, which had earned the gratitude of all present.

An informal luncheon was held at the Premier Restaurant, Dover Street, London, W.1, at which the Hon. Treasurer was host.

Section Activities

Belfast and District

Detergent Action. Professor N. K. Adam, F.R.S., was the guest speaker at the first meeting of the session on 10 October in Queen's University. He chose as his subject 'The Mechanism of Detergent Action.'

He began by saying that, in aqueous solution, detergents roll up grease into small globules on the solid surface, while in the absence of detergents in the aqueous phase, the grease is spread more or less uniformly as a film on the solid. This involves changing the contact angle θ_{wo}, measured in the water, between the grease–water interface and the solid surface from 180° to zero. Applying the usual equation for the equilibrium of surface tensions at a solid surface,

$$\cos \theta_{wo} = \frac{\gamma_{so} - \gamma_{sw}}{\gamma_{wo}}$$

γ_{so}, γ_{sw} and γ_{wo} are the surface free energies (surface tensions) of the solid–grease, solid–water and grease–water interfaces. Water-soluble detergents are adsorbed, and reduce the surface tension at the grease–water and solid–water surfaces: both these effects tend to decrease θ_{wo}. Grease in the form of small globules is more easily detached by slight mechanical agitation than when it is spread over a large area of solid surface in a thin layer. The lowering of the grease–water tension, γ_{wo}, facilitates emulsification of the grease and hinders re-deposition. Cationic paraffin-chain salts are very poor detergents, because (at least on negatively-charged solids) they are adsorbed with their paraffin ends outwards and, therefore, do not decrease γ_{sw} effectively. To use the name 'detergents' for these substances is misleading, for they do not deterge as the anionic salts do. Non-ionic detergents are usually derivatives of polyethylene oxide. There is a tendency to over-emphasize the importance of foam or lather in detergent products because even soap, the old-fashioned yet excellent detergent, washes quite well if the lather is destroyed with a foam-killing agent. D. G. Stevenson, however, discovered two useful actions of foam: it concentrates the oily dirt into the very thin junctions between the lamellae constituting the foam, thus assisting emulsification when the foam is broken during rinsing; and foam moving over the solid surface can act as an extremely delicate brush, which detaches the rolled-up globules of grease.

Professor Adam used a number of slides to illustrate the viscous, usually double-refracting, complexes which are formed when detergents act on solids containing some polar material. These are rather similar to the long-known 'myelin' figures formed with some natural lipids in water or detergent solutions. After answering a number of questions, Professor Adam was thanked by the Chairman, Professor C. Kemball.

Cardiff and District

Nuclear Resonance Spectroscopy. A joint meeting with the South Wales Section of the Society of Chemical Industry was held on 20 September at the Newport and Monmouthshire College of Technology, Newport. Mr J. S. Hughes was in the Chair and Dr R. E. Richards, of Lincoln College, Oxford, addressed the meeting on 'Recent Development in the Chemical Applications of Nuclear Resonance Spectroscopy.'

The lecturer began by giving an elementary account of the principles upon which nuclear magnetic resonance is based. He showed that an atomic nucleus with 'spin' characterized by the quantum number, I, also possesses a magnetic moment, μ, which arises from the circulation of electric charge associated with the rotation of the positively-charged nucleus. If such a nuclear magnet is placed in a strong uniform magnetic field it must occupy one of $(2I + 1)$ energy levels. The nuclear magnetic resonance experiment, therefore, involves the 'flipping' of the nucleus from one level to another.

Thus, if a system of nuclei in a magnetic field, H, is subjected to radiation of frequency, ν, such that

$$h\nu = \Delta E = \frac{\mu H}{I} \qquad \ldots \qquad (1)$$

where ΔE is the energy difference between two adjacent energy levels and h is Planck's constant, then transitions of the nuclei among the energy levels may be induced, and a nuclear resonance spectrum may be observed.

Dr Richards went on to say that the n.m.r. line widths depend on the state of aggregation of the sample, that is solids give broad lines of the order of 10^4 c/sec, whilst liquids give narrow lines of the order of 10^{-1} c/sec.

H, in equation (1), is the magnetic field actually experienced by the nucleus and is, in fact, less than the field H_{appl} which is generated by the magnet. Equation (1) therefore becomes

$$h\nu = \frac{\mu}{I} H_{appl} (1-\sigma) \qquad \ldots \qquad (2)$$

where σ varies with the electron distribution about the nucleus and hence with the chemical environment of the atom. Therefore, in a given H_{appl}, a particular nucleus gives a number of n.m.r. lines corresponding to the different chemically-distinguishable nuclei of this kind present, *e.g.* acetaldehyde gives two lines due to the CH_3- and $-CHO$ groups and their intensities are in the ratio 3 to 1. Other examples were also given, showing that the technique is a good diagnostic device in organic chemistry.

Under high resolving power, the proton resonance lines show fine structure, for example in acetaldehyde the CH_3- line shows two peaks and the $-CHO$ line four peaks. This arises from interactions between the protons in the two groups.

The technique has been applied to other nuclei, *e.g.* it has shown the existence of two kinds of Tl nuclei in

Tl_2Cl_3 and it has been applied to the study of 'ion-pair' formation in certain cobalt(III) complexes.

Dr Richards then gave a brief description of electron spin resonance, which is 1,000 times as strong as nuclear magnetic resonance.

An interesting discussion followed the lecture. Dr L. E. Coles and Mr G. H. Macadam proposed votes of thanks on behalf of the audience, many of whom were students.

Cumberland and District

The Dyestuffs Industry in Carlisle. It has been the custom in recent years to hold one Section meeting in Carlisle, and this year it was held jointly with the Cumberland Textile Society. Dr F. H. Day, District Member of Council, gave an account of 'The History of the Dyestuffs Industry in Carlisle.'

The speaker dealt mainly with the activity in the industry between 1916 and 1924, after which the operations were transferred to Grangemouth. The chief feature of this project, initiated by the late Sir James Morton, was the production of anthraquinonoid dyestuffs necessary for the dyeing of guaranteed fast fabrics. After early technical difficulties with plant and supply of raw materials, considerable success was achieved, culminating in the discovery of the valuable dimethoxy-dibenzanthrone called Caledon Jade Green.

The lecture, which was well attended, was illustrated by slides showing the early plant and specimens of some of the original pattern books and so on.

The chairman of the Cumberland Textile Society, Mr W. Burgess, proposed the vote of thanks.

East Anglia

Analytical Research. A large number of members attended a meeting held at Manningtree on 28 September at which Dr J. Haslam gave a lecture entitled 'Analytical Research.'

Dr Haslam gave a detailed description of analytical research work in the alkali and plastics industries. He provided information on the training of analytical research chemists and on sources of ideas likely to be profitable in their work. Finally, the various stages in the development of a new analytical method for the detection and semi-quantitative determination of 'additional elements' in plastic materials were discussed.

Mr H. F. Bamford was in the Chair and the vote of thanks was given by Mr W. C. Hanson.

Glasgow and West of Scotland

Exhibition of Apparatus. The Second Exhibition of Chemical Laboratory Apparatus organized by the Section was held in the Royal College of Science and Technology, Glasgow, on 20, 21 and 22 September. Twenty-three firms took part, and it was necessary to bring a third laboratory into use for display purposes. The number of visitors recorded was 475.

Among the features of particular interest were closed-circuit television for use in schools and colleges, gas chromatography apparatus, spectrophotometers and zone-melting equipment. A variety of the basic requirements for all laboratories were also shown.

Hull and District

Scientific Film Evening. The first meeting of the Session, the customary film evening, was held on 4 October at the Francis Reckitt Institute, Hull. Senior pupils from local schools were specially invited.

The following films were shown: British Refined (Aims of Industry Film Library); Crystallization (Imperial Chemical Industries Ltd); No Rust Here (Central Film Library); Bond of Service (Central Film Library); and Scientific Manufacture of Printing Inks (Coates Bros Inks Ltd).

Thanks were expressed to Reckitt & Sons Ltd for the facilities provided.

London

Chemical Control of Plant Growth. A meeting was held at Brighton Technical College on 10 October. The Chairman of the meeting, Dr J. E. Salmon, introduced the speaker, Professor R. L. Wain, F.R.S., who lectured on 'The Chemical Control of Plant Growth.'

Professor Wain first dealt briefly with the early work which led to the discovery that plant growth is influenced and controlled by hormones—extremely potent chemicals which are elaborated by the plant itself. The recognition of one of these substances as indole-3-acetic acid led to important chemical, physiological and agricultural developments, and at the present time a wide range of active synthetic compounds is available for the control of plant growth. An account was given of some of the ways in which these materials are being used to increase crop production. Research carried out in Professor Wain's laboratory on the relationship between chemical structure and biological activity and on mode of action was described. The lecturer also traced the development of a new group of selective weedkillers possessing a unique mode of action.

Returning to the subject of natural plant growth, Professor Wain discussed other types of growth-regulating compounds, such as the gibberellins, which are now known to occur in plants; he also mentioned the importance of hormone inhibitors—compounds which might play a key role in the dormancy of buds and seeds. Research on an inhibitor of this type is now proceeding at Wye College.

A spirited discussion followed the lecture and the vote of thanks was proposed by Mr N. F. N. Niblett, chairman of the Technical College Chemical Society.

British Launderers' Research Association. A party of members recently visited the laboratories of the British Launderers' Research Association at Hendon. After

welcoming the visitors, the director, Mr J. Leicester, gave an explanatory talk on the Research Association as well as mentioning those departments (chemical engineering, special projects, information and technical service) which it would not be possible to visit. The party was then divided into three groups for a tour of the various departments.

In the analytical and fabrics section, the effects of incorrect washing and finishing on garments made from a number of fibres were vividly demonstrated by a wide variety of examples. Work on corrosion problems was illustrated by a bench working model.

The microscopical work on the mechanism of fatty dirt removal by detergents was displayed by the staff of the chemistry division, who also showed bacteriological work on the hygiene of washing and the disinfection of blankets. The use of radioactive materials in the study of detergency was illustrated.

In the physics department removal of dirt by ultrasonic methods was demonstrated.

Visitors were then conducted round the experimental laundry, which is equipped with the latest types of machinery found in the industry, and is used to demonstrate on a commercial scale the findings of the other divisions of the Association.

During tea visitors had the opportunity of meeting and talking to members of the staff of the Association. Mr Corbett concluded the proceedings with the vote of thanks to Mr Leicester and the Association.

MANCHESTER AND DISTRICT

Heinz Food Factory, Wigan. A party of members visited Heinz's Food Factory at Wigan on 7 September.

They were welcomed by Dr G. Tattersall and then, in groups of four, toured the factory. The tour began with the administration and control blocks, and then proceeded to the factory itself, starting at the receiving stores, the beginning of the food-canning process. Next came the preparation room, where the vegetables were being inspected, cleaned and scalded. It was interesting to note that every single bean of some 100 tons used in a day was individually examined and passed or rejected in the preparatory examination. The next step in the production line is the actual cooking of the vegetables and the preparation of sauces, soups and baby foods. These are then packed in cans from a conveyer, which is fed from a completely separate can-manufacturing unit. All plant and utensils used for these processes are of stainless steel, and the most modern devices, to ensure the purity of the final product, are installed at each stage.

One of the main interests of the plant is the magnificent design and arrangement of buildings and plant to give the greatest possible amount of free space, which permits easy and complete sterilization of the entire building. All services are carried in a 4-ft space between floors and all lighting is sealed off from the working areas. Floors are tiled and sloped for rapid drainage. The complete plant is cleaned each day, both physically and chemically, and a five-and-a-half hour

period after packing has ceased. After the initial preparation, the food is untouched by hand. The chief controls, after initial quality acceptance control and mechanical can-testing, are bacteriological, and all processes and cleaning operations are carried out under the rigid control of this department.

The party was entertained to tea in the canteen, and many questions were asked. Dr L. R. Ridgway thanked the company, Dr Tattersall and his staff.

MID-SOUTHERN COUNTIES

Chemistry of Wines and Spirits. On 13 October, the Section began its season of winter lectures with a meeting at the College of Technology, Portsmouth. The meeting was held jointly with the Portsmouth and District Chemical Society, and the speaker was Dr E. C. Barton-Wright.

The lecturer gave a brief historical introduction to the subject, from Neolithic man to the present via Genesis ix, 20–21. Most European countries define wine as a product obtained from the fermentation of the juice of fresh grapes, and so Dr Barton-Wright concentrated on the major chemical reactions involved in the fermentation of grape juice. The roles of sugars and inorganic acids were quickly dealt with, and the lecturer passed on to a fascinating account of the yeast and moulds that give us the great variety of wines.

Many gaps in present-day knowledge of the composition of grapes and the fermentation process need attention, especially the role of the nitrogen constituents of grape juice in fermentation. The nitrogen metabolism involved in the fermentation of grape juice has been little studied, and so the lecturer turned to the better understood fermentation of wort in brewing.

An account of the production of two fortified wines, port and sherry, and one sparkling, champagne, was given with practical details.

Dr Barton-Wright concluded: 'There is, however, one thing I must implore you not to do and that is to think of wine, which is after all a gift from the gods to suffering humanity, in terms of pure chemistry. Wine should be looked upon as a living being. It is a thing of beauty and has a soul. It passes from brash green youth to majestic maturity and then to senility and death. But in its majestic maturity it is the support and faithful friend of mankind and well may one cry with Solomon: "Stay me with flagons".'

The vote of thanks was proposed by Mr D. H. Bell.

North Lancashire

Ion-Exchange Resins. A joint meeting with the Harris College, Preston, was held at the College on 3 October. The meeting comprised a lecture and film show entitled 'Ion-Exchange Resins'; the lecture was given by Dr V. E. Gripp and the film shown by permission of Permutit Ltd.

Dr Gripp outlined the basic process of ion exchange, and went on to consider the properties and operating conditions for strong and weak anion and cation exchangers.

Attention was then drawn to the effect of the particle size of the resin beads and the consequent dependence of rate of exchange on the diffusion of ions through the resin. The extent of cross-linkage required to yield an insoluble resin, and the further cross-linkage required to produce a resin in which physical change is kept to a minimum during the exchange process, was discussed.

Dr Gripp then went on to describe a number of uses, both laboratory and industrial, of ion-exchange resins. Laboratory applications included the determination of equivalent acidity, and the separation of phosphate and strontium as well as the use of a strong anion exchanger for the separation of nickel and cobalt. Industrial applications described covered the separation of uranium, the rare earths and water purification.

The lecturer concluded with a short account of more recent developments in the field of mixed-bed ion-exchange resins and ion-exchange papers.

Mr J. Donnelly proposed the vote of thanks; the film was then shown.

Tees-Side

Annual General Meeting. The A.G.M. was held at the William Newton School on 4 October. The following were elected Officers and Members of Committee: Chairman, Dr D. G. Jones; Hon. Treasurer, Dr A. A. L. Challis; Hon. Secretary, Dr G. H. Mansfield; Members of Committee, Messrs F. H. Foster, F. E. Harper, E. Kenefec and T. D. Rees, and Drs J. M. Skinner, A. Sykes and F. M. Tayler. Dr A. C. Docherty and Mr R. Parmella were elected Hon. Auditors.

The Hon. Treasurer's report, unanimously adopted, showed that income matched expenditure for the 1960–61 session as a result of participation in lectures with the Chemical Society and the Society of Chemical Industry. The Hon. Secretary's report outlined progress in the past years and detailed results of a questionnaire sent to members, to assess what activities were of most interest. The results had been used in planning the programme for the 1961–62 session.

The retiring Chairman, Dr I. J. Faulkner, thanked the Committee for their help during his term of office.

Eastern India

Annual General Meeting. The eighth A.G.M. of the Section was held at the auditorium of the Central Food Laboratory, Calcutta, on 5 July, with Dr N. K. Sen as Chairman.

The minutes of the previous Annual General Meeting, the Hon. Secretary's Report for 1960 and the audited statement of accounts for the year ending 31 March, 1961, were approved.

Messrs Pal and Roy, Chartered Accountants, Calcutta, were re-elected Hon. Auditors for 1961–62.

The formal business was followed by the Chairman's address, "A Short Review of the Development of Forensic Sciences in India.' Dr Sen explained that at the conferences of home ministers in Delhi in January, 1954, the important decision was made to improve the method of detection of crime by modern scientific technology, and for that purpose to set up a chain of forensic science laboratories in different states as well as a central laboratory under the home department.

It was gratifying to note from Dr Sen's speech that the University Grants Commission recently agreed to include forensic science and criminology as a post-graduate diploma course, and attempts are now being made to include it in the curriculum of B.A. and B.Sc. courses at Indian universities; in fact Saugar University has included these subjects in B.A. and B.Sc. courses since 1958. Dr Sen pointed out that at a meeting of forensic scientists held in March, 1960, it was decided to inaugurate an Indian Academy of Forensic Sciences, its object being to promote forensic science in India. The Academy will provide a meeting ground for members of the legal profession, police and forensic science specialists, and will also undertake to publish a journal in due course.

A lively discussion took place after the talk, and the meeting ended with the vote of thanks to the Chair proposed by Professor R. N. Chakravarti.

At a subsequent Committee meeting held on 6 September at the Medical College, Calcutta, the following were elected as Officers and Members of Committee for 1961: Chairman, Professor N. K. Sen; Vice-Chairmen, Professor R. B. K. N. Bagchi and Mr N. Sen; Hon. Secretary, Dr D. B. Das; Hon. Treasurer, Professor R. N. Chakravarti; Members of Committee, Drs H. K. Banerjee, A. Lahiri, S. C. Ray, A. B. Sen Gupta, N. C. Sen Gupta and P. N. Sen Gupta, and Mr S. N. Mitra.

News and Notes

EXHIBITIONS AND AWARDS

Beit Fellowships for Scientific Research.—Normally one Fellowship of annual value £600, in addition to college fees, will be awarded each year. The tenure of a Fellowship will be for two years, subject to a favourable report by the supervising professor. Men and women candidates, of European descent by both parents, must be under 25 and hold a degree of a university in the British Commonwealth or a diploma or associateship of an approved college. The holding of any other scholarship or fellowship disqualifies.

Applicants must give full information as to qualifications, academic standing and previous career, and state the general character of the research which they propose to carry out and the names of not more than three referees, one of whom shall be a teacher of the college or university at which the candidate took his or her examination. No testimonials should be sent.

Application forms may be obtained from the Registrar, Imperial College of Science and Technology, Prince Consort Road, London, S.W.7, and must be returned not later than 1 February, 1962.

British Coking Industry.—The British Coking Industry Association is again offering a number of scholarships to provide suitable candidates with a university course in chemical engineering or fuel technology, followed by a period of postgraduate practical training to equip them for responsible positions in the coking industry, particularly in plant management.

Full conditions of award, including a detailed syllabus of the postgraduate training and application forms may be obtained from the Secretary, British Coking Industry Association, 74 Grosvenor Street, London, W.1. Completed forms must be returned not later than 31 December.

National Coal Board.—The National Coal Board will again offer up to 100 University Scholarships to give boys leaving school, and young men already at work in the coal industry, the best education and practical experience that can be offered to fit them for a career in the industry, leading in due course to posts of high managerial and technical responsibility.

The majority of the awards will be given for university courses in mining engineering; a number will also be given for courses in chemical engineering, mechanical engineering, electrical engineering and fuel technology. Awards will also be available to graduates in science or engineering to enable them to qualify within two years as mining engineers.

Full particulars may be obtained from the Staff Department, National Coal Board, Hobart House, Grosvenor Place, London, S.W.1.

O.C.C.A. Technical Exhibition.—The Fourteenth Technical Exhibition of the Association will take place from 26 February to 1 March (*see J.*, 286). The Exhibition Committee has announced that the Rt Hon. Viscount Hailsham, Q.C., will be the guest of honour at the luncheon to be held at the Criterion Restaurant on 26 February. He will also open the Exhibition, which takes place at the Royal Society's Old and New Halls, at 3 p.m. that day. Copies of the official guide and forms of application for luncheon tickets will be sent, free of charge, to those applying in writing to R. H. Hamblin, Wax Chandlers' Hall, Gresham Street, London, E.C.2, before 31 December.

Perkin Centenary Trust.—The Perkin Centenary Fellowship is offered for one or two years for the purpose of higher study of an approved subject. Candidates will be required to show either that they have had experience in an industrial firm or other institution concerned in the manufacture or application of colouring matters, or that their intended field of study has a direct bearing on these subjects. The value of the Fellowship is £750 per annum with an additional grant of up to £100 towards certain designated expenses; it is tenable from October, 1962, at any approved university, technical college or other institution.

Two Perkin Centenary Scholarships are offered, each for two years from October, 1962, and renewable at the discretion of the Trustees for one further year, to enable candidates employed in an industrial firm or other institution concerned with the manufacture or application of colouring matters to receive an education at a university or technical college. Each award will have a value of £350 per annum. There is no means test, and a successful candidate is not debarred from receiving the whole or a part of his normal salary from his employers during his tenure of the Scholarship.

Further details and application forms may be obtained from the Secretary of the Trust, c/o The Chemical Society, Burlington House, London, W.1. The closing date for the receipt of applications is 1 May, 1962.

Worshipful Company of Horners Award.—A prize of 100 guineas is offered to encourage young craftsmen in plastics. The award is administered by the British Plastics Federation, on behalf of the Worshipful Company of Horners, and is open to all those resident in Great Britain and Northern Ireland who will be under 35 years of age on 1 December. The subject selected for competition is a design for production wholly or mainly in plastics materials. The judges will look for artistic merit, originality and practicability of design, as well as the suitability of the plastics materials specified for individual entries. Entries must be received by 1 December, and further details and application forms may be obtained from the British Plastics Federation, 47–48 Piccadilly, London, W.1.

MEETINGS AND CONFERENCES

Diffusion and Mass Transport in Solids.—The Institute of Physics and the Physical Society announces that it is arranging a conference on this subject to be held in the University of Reading on 10–11 April, 1962. A number of papers have been promised and further contributions will be considered. It is proposed to hold sessions on general theoretical aspects of diffusion in solids and on diffusion and related mass transfer phenomena in metals, in oxides and covalent materials and in strongly ionic solids. The conference will be residential and the numbers will be limited. Further particulars and application forms will be available in January from the Administration Assistant, 47 Belgrave Square, London, S.W.1. Correspondence regarding the programme should be addressed to Dr B. L. Evans, J. J. Thomson Physical Laboratory, Whiteknights Park, Reading, Berkshire.

Feigl Anniversary Symposium.—An international symposium on analytical chemistry, organized by the Midlands Section, Society for Analytical Chemistry, will be held at the University of Birmingham on 9–13 April, 1962, in honour of Professor F. Feigl, to commemorate his seventieth birthday. Plenary lectures will be given by Professor R. Belcher (U.K.), Professor Dr Ing. F. Feigl (Brazil) and Professor P. W. West (U.S.A.). There will be a half-day conference on the morning of 13 April dealing with 'The Teaching of Analytical Chemistry,' to which all delegates are invited. Further details and application forms may be obtained from the honorary symposium secretary, Mr M. L. Richardson, c/o John & E. Sturge Ltd, Lifford Chemical Works, Lifford Lane, King's Norton, Birmingham, 30.

Industrial Water and Effluents Group.—The inaugural meeting of the new Industrial Water and Effluents Group of the S.C.I. was held at the Royal Institution on 1 November. The Group chairman, Dr B. A. Southgate, C.B.E., gave a talk on the Group, and the chair was taken by the Lord Fleck, K.B.E., F.R.S., President of the S.C.I.

International Society for Fat Research.—The Sixth I.S.F. Congress, which will be held in London on 9–13 April, 1962, will be formally opened by the Lord Fleck at the Plenary Meeting on 10 April. Lectures at the Plenary Meetings will be delivered by Mr J. C. A. Faure (Unilever), who will consider commercial trends in oils and fats supplies from a world point of view; by Dr D. Swern (U.S. Department of Agriculture), who will speak on industrial utilization of fats; and by Professor A. C. Frazer (University of Birmingham), who will discuss recent developments in the biochemistry of fats. The preliminary programmes of the Congress will be available in the near future from the Congress Secretariat, 14 Belgrave Square, London, S.W.1.

The Ionosphere.—A conference on this topic is being arranged by the Institute of Physics and the Physical Society to take place in London on 2–6 July, 1962. Subjects to be covered are: ionospheric constitution and ionizing radiations (Dr H. Friedman, U.S. Naval Research Laboratory, Washington); geomagnetism and the ionosphere (Dr C. O. Hines, Defence Research Telecommunications Establishment, Ottawa); irregularities in the ionosphere (Dr B. H. Briggs, Cavendish Laboratory, Cambridge); and mathematics of wave propagation through the ionosphere (Professor H. G. Booker, Cornell University). Offers of other contributions are invited. These should be accompanied by an abstract of 100–150 words each and be sent to the chairman of the Organizing Committee, Mr J. A. Ratcliffe, at the Radio Research Station, Ditton Park, Slough, Buckinghamshire, before 1 March. The final scripts will be required by 1 June. The official languages of the conference will be English and French. Further particulars will be available at the end of March from the Administration Assistant of the Institute and Society, 47 Belgrave Square, London, S.W.1.

Iron and Steel Institute.—The Autumn General Meeting will be held on 29 November to 1 December. Sessions will be held at the Federation of British Industries, Tothill Street, London, S.W.1, and at the offices of the Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W.1. The technical sessions will comprise a symposium on 'The Future of Ironmaking in the Blastfurnace,' short sessions on the thermodynamics of slags, oxidation and scale, bainite and high-alloy steels, and a session on the energy balance of integrated iron and steelworks. Special lectures on 'The British Steel Industry and the Common Market' will be given by Mr C. R. Wheeler, C.B.E., and H. E. Dr E. N. van Kleffens, on the evening of 29 November at the Hoare Memorial Hall, Church House, London, S.W.1. Admission will be by ticket only. Further details may be obtained from the Secretary of the Iron and Steel Institute.

Man-made Fibres.—The Second World Congress of Man-made Fibres will take place in London on 1–4 May, 1962. The programme comprises two general addresses and two major lectures to be given in Plenary Sessions at the Royal Albert Hall. Many technological papers for discussion will be presented during four separate Conference Sessions in the Connaught Rooms. Highlights will be a lecture on man-made fibres and the consumer, by Dr E. Kann, a director of Marks & Spencer Ltd, and one on the role of fashion in textile evolution by M. Jacques Heim, president of the Chambre Syndicale de la Couture Parisienne. Some 3,000 delegates will attend the Congress by invitation only. Further details may be obtained from the Congress offices, Sceptre House, 169 Regent Street, London, W.1.

Materials in Space Technology.—The British Interplanetary Society is holding a symposium on this subject in the lecture theatre, Royal Aeronautical Society, 4 Hamilton Place, London, W.1, from 9.30 a.m. to 5.30 p.m. on 22 November. Registration is necessary. Programmes and application forms may be obtained from the Secretary, British Interplanetary Society, 12 Bessborough Gardens, London, S.W.1.

Plastics Institute.—The annual joint symposium of the North-Western Section of the Plastics Institute and the Manchester Section of the Institution of the Rubber Industry will be held on 8 December at, and in collaboration with, the Moston College of Further Education. The title of the symposium will be 'Degradation of High Polymers.' Further details may be obtained from C. Pollard, c/o The Geigy Co. Ltd, Rhodes, Middleton, Lancashire.

The annual Young People's Lecture of the Plastics Institute will be held on 5 January, 1962, at 2.30 p.m. at the Institution of Electrical Engineers. Professor M. Stacey, F.R.S., will talk on 'Nature's Plastics.' Tickets may be obtained from the Plastics Institute, 6 Mandeville Place, London, W.1.

Water Pollution Research.—The International Conference on Water Pollution Research will be held in London on 3–7 September, 1962. Subjects of symposia include self-purification of fresh-water streams and the effects of pollution on fisheries; treatment of sewage and industrial wastes; and effects of pollution on the marine environment. Further details may be obtained from the Scientific Conference Centre, Pergamon Press Ltd, Headington Hill Hall, Oxford.

A NATIONAL SPECTRA INDEX: PLANS AND PROBLEMS

At a meeting of the Infra-Red Discussion Group at the University of Reading on 26 September, a talk was given by Dr P. S. Davison, of the Scientific Documentation Centre, Halbeath, Dunfermline, on the need for a National Spectra Index and some of the problems its creation would present.

Support is being sought from industry and interested organizations for the establishment of such a central index for infra-red and ultra-violet data. Dr Davison outlined the reasons why this was needed, and mentioned how the present spectra collections could not adequately meet many requirements for spectroscopic data; with the extremely rapid increase in the use of spectrometric methods of analysis, such requirements are growing. It is intended to collect data from both literature and laboratory sources, and efforts to gain the co-operation of holders of the existing spectra collections have had some success. By avoiding the high costs of printing spectra, most of which will be infrequently used, it is believed that a collection much larger than any extant could be quickly compiled, indexed by compound and spectrum, and used to provide photocopies for users.

To handle such large collections, improved means of mechanical searching for spectra, probably in terms of their shapes, will be needed. Much more of the information in the spectrogram must be coded than is yet possible, so as to allow much greater precision in sorting than can be achieved with present punched-card methods. The available techniques were discussed, and an outline given of a photoelectric masking method, details of which were published in the April and May issues of *Research*. It was proposed that the masking method, which would allow group searching with greater ease than is now possible, and also allow searching with a higher degree of definition than with punched cards, be tested.

The talk was followed by much lively discussion, in which many members of the Group put forward helpful suggestions. It was thought that it would be possible to adapt the photoelectric method to deal with some of the difficulties pointed out in the discussion.

Towards the end of the discussion, the meeting was asked by the chairman to vote on whether members would support a central spectra library, and a vote of 70 to 0 in favour was given; on the question whether members would support further research into means of handling spectra, a vote of 12 to 0 in favour was recorded. Earlier, in response to a direct question, no member of the audience had indicated that he found the existing services adequate.

RECENT PUBLICATIONS

Sandwich Courses.—The latest *List of Sandwich Courses and Block Release Courses* published by the Ministry of Education (List 182: H.M.S.O., 6*s*.) illustrates the rapid development of the technical training programme. There are 374 sandwich courses (compared with 332 last year) and 138 block-release courses (compared with 48 last year) now being offered at colleges of advanced technology and other technical colleges.

Of the sandwich courses, 35 are offered in the field of chemistry, as are two block-release courses. The chemistry courses include some in industrial and applied chemistry with specialization in a particular technology, *e.g.* glass technology, dyeing and finishing. Most of the sandwich courses lead to H.N.D., university degree, Dip. Tech. or Grad. R.I.C. qualifications. The majority of the sandwich courses are of four years' duration.

Teachers in Technical Colleges.—A report by the National Advisory Council on the Training and Supply of Teachers entitled *Teachers for Further Education* (H.M.S.O., 1*s*. 3*d*.) sets out the requirements for technical college teachers during the next few years. It is estimated that the number of technical college teachers needed in 1963–64 will be 27,235 (a 52 per cent

increase over the number in 1959–60, which was 17,916) and about 37,000 by 1969–70. No allowance has been made in these figures for any new developments in technical education. It will be necessary to recruit 3,600 teachers annually to achieve the 1970 total. For chemistry, including applied chemistry, it is estimated that more than 500 additional teachers will be required by 1963–64; this is an increase of 55 per cent from 1959–60, during which session 939 full-time teachers of chemistry were employed in technical colleges.

Science Museum Subject Catalogue.—The second book in what may grow into a series of catalogues of the Science Library, each covering a large division of the collections, is entitled *Books on the Chemical and Allied Industries*, compiled by L. R. Day (London: H.M.S.O., 1961. 12*s*. 6*d*. net). The first catalogue was devoted to engineering, and it is intended that there shall be a future one on pure chemistry. As this is a catalogue of actual books in the Science Library, it is hoped that readers will now be able to take greater advantage of the books available in the Library, and also that they will continue to indicate additions which are in their opinion indispensable.

Royal Society Tercentenary.—A book of this title has recently been produced by *The Times* in response to insistent demand. It will be recalled that a special number of *The Times* was devoted to the Tercentenary celebrations, and the present volume is based upon that issue. Price 30*s*.

High Purity Metals.—The latest series of data sheets issued by Johnson, Matthey & Co. Ltd covers their range of High Purity Metals. Information is given on 38 metals, including noble, rare earth and certain base and rarer metals. The general properties of each element are tabulated and details are given of the forms of current production. In most cases the metals are available in more than one grade, the metallic impurity contents being expressed in parts per million. The data sheets are freely available on request to the company's head office, 73–83 Hatton Garden, London, E.C.1.

Qualitative Analysis.—A United Kingdom edition of Professor Edward J. King's *Qualitative Analysis and Electrolytic Solutions* (reviewed in *J*., 1960, 329) has been published by Oliver & Boyd Ltd, at the considerably reduced price of 45*s*.

Approved Names.—The General Medical Council has published a supplementary list of Approved Names, dated October, 1961. The list is available from the Secretary, British Pharmacopoeia Commission, 44 Hallam Street, London, W.1.

The Colour Group.—The memorandum and articles of incorporation of the Group, drawn up by Solicitors, have been examined by and discussed with the Board of Trade and are now in a form suitable for the final legal action. A meeting of members of the Group will be held at 4 p.m. on 30 November in the Library of the Institute of Physics and the Physical Society, 1 Lowther Gardens, Prince Consort Road, London, S.W.7, when the Solicitor will be present to answer questions and discuss the memorandum and articles and the legal action to be taken. Any member wishing to have a copy of the memorandum and articles is asked to write to the secretary, F. J. B. Wall, Ramsden Colour Laboratory, Ilford Ltd, Woodman Road, Brentwood.

Commonwealth Visiting Fellowship.—Professor L. H. Briggs, of the University of Auckland, New Zealand, has accepted a Commonwealth Visiting Fellowship for the academic year 1961–62, attached to the University of Aberdeen. He is expected to arrive this month.

Fuel-Cell Research and Development.—The British Petroleum Co. Ltd, British Ropes Ltd and the Guest, Keen & Nettlefolds Group have joined with the National Research Development Corporation to form a new company, Energy Conversion Ltd, to promote research into the development of fuel cells. The company's registered office will be at Britannic House, Finsbury Circus, London, E.C.2. Although working versions of fuel cells have been demonstrated, none have yet been produced commercially. Various other British, German, Scandinavian and American organizations and companies are also known to be working in this field, in which interest has increased markedly in recent years.

Natural Gas in New Zealand.—A natural-gas field which promises to yield 100 m. cubic feet of gas a day when fully developed has been discovered at Kapuni, Taranaki Province, North Island, New Zealand. The New Zealand Prime Minister, Mr Holyoake, made this announcement on 19 October after discussions with the Shell, B.P. and Todd Oil companies, which have spent £5 m. on investigating the oil and natural gas of the Taranaki area. Mr Holyoake spoke of using the gas for smelting hitherto unused ironsands, of which many New Zealand beaches are composed, to start a local iron industry.

QVF Factory in Germany.—On 12 October a £150,000 industrial and scientific glassware factory was opened at Schierstein, near Wiesbaden, for QVF Glastechnik GmbH, a subsidiary of QVF Ltd, Stoke on Trent. The factory will also be used by Quickfit & Quartz Ltd, who earlier this year formed their own German subsidiary, Quickfit Laborglas GmbH.

Scientific Film Association.—At its Fifteenth Annual Congress, held in Rabat, Morocco, the International Scientific Film Association elected Edgar Anstey, leader of the British delegation, as its new President. Mr Anstey is President of the British Scientific Film Association.

CORRESPONDENCE

CHEMICAL BOND APPROACH

SIR,—We understand that some difficulties have arisen over the definition we offered (*J.*, 156) for 'equivalent weight' in terms of amount of material involved in the transfer of one proton or electron. These difficulties disappear when the concept is referred to the molar level, for the equivalent (formerly the gram-equivalent-weight) is seen to be the mass of material associated with the transfer of one *mole* of protons or electrons.

It is gratifying that articles and letters about new approaches to the presentation of chemistry at school generate such a spate of re-thinking and re-defining. Now we must flavour and lighten the new preparations to the point where they are digestible by the youngsters for whom they are intended. In this connection, will Mr Copley's suggestion (*J.*, 384) for adopting the term 'molar mass corresponding to functional formula' to mean the amount of material now generally denoted by 'equivalent' really help a schoolboy to see the point of experimental equivalence? Retention of the word equivalent does *not* mean that the unnecessary word 'normality' must be retained also.

W. F. COULSON
D. G. O'SULLIVAN
JOHN B. JEPSON

Courtauld Institute of Biochemistry,
Middlesex Hospital Medical School,
London, W.1

INFRA-RED SPECTROSCOPY

SIR,—In the very interesting article 'Infra-red Spectroscopy for Undergraduates' by Dr Davies (*J.*, 301–2), it is pointed out that some instruments with rock-salt optics have insufficient resolving power to cover adequately the R-branch of the HCl absorption spectrum. I suggest that a more suitable gas to use for the study of the rotation–vibration spectrum of a diatomic molecule is carbon monoxide, for which the Q-branch (vacant) occurs at about 2,150 cm^{-1}, and for which over 20 bands in the P and R branches are easily resolvable. The bands are very sharp, no isotope effect being discernible. The pressure used need only be about 10 cm Hg, and the purity of the gas obtained by the action of sulphuric acid on a formate, followed by passage through soda–asbestos, is adequate.

Although it is not possible to study isotopic shifts or the effect of varying mass, as in the series HCl, DCl, HBr, HI, etc., it is possible to compare the spectrum with that of NO, the result of which can be rewarding.

L. H. W. HALLETT

Rutherford College of Technology,
Newcastle upon Tyne

SCRUPLES ABOUT GRAMMES

SIR,—Mr Bullock's problem about the 'damn dot' which converts a handwritten *gram* into a *grain* seems to have been solved long ago by the REAL chemists (members of the Pharmaceutical Society) exactly as Messrs Bullock and Bourne have solved it. Thus on p. 8 of the *British Pharmacopoeia* there appears the statement that 'quantities of 0·1 gramme or more are usually expressed in grammes or fractions of a gramme; smaller quantities are expressed as milligrams. . . .' Note how exhaustion prompts even the B.P. Commissioners to drop the final 'me' when there is no risk of confusion.

I believe the question of how these units should be abbreviated has had a recent airing in another journal, but no harm will result from pointing to the B.P.'s use of G (although Hodgman's *Handbook of Chemistry and Physics* already has two abbreviations, g and gm, for gramme).

It seems curious that the most widely used unit should cause so much confusion, just as we who practice chemistry belong to the nameless profession. As I remarked above, the title 'Chemist' belongs as a registered name to the Pharmaceutical Society. I now find that the use of the name 'Analyst' causes my lay brothers to think of me as a healer of the mind, or as a Statistician. I regret to say that I have qualms about using the description 'Scientist,' which would put me in the ranks of Galileo and Leonardo Da Vinci, and simply to put 'The Nameless Profession' on official forms seem to confuse it with the oldest profession . . . which, I believe, is nursing.

Has anyone a suggestion about this? I would humbly submit, as a catalyst, the name 'Queeriosity.'

A. C. BUSHNELL

'Westway,' Skip Lane,
Hutton, Nr Preston

[Neither born chemists nor even natural philosophers have been able to solve this last problem—ED.]

SIR,—Due to recent criticism,
Gramme's a Bacharachronism.

S. H. JENKINS

Rookery Park, Erdington,
Birmingham, 24

[This correspondence is now closed—ED.]

OBITUARY

John Andrews. *B.* 29.9.1884. *Ed.* Dublin Technical School, 1901–10. B.Sc. (Lond.). He entered the services of Arthur Guinness, Son & Co. (Dublin) Ltd as a boy in 1900 and retired as chief chemist of the same firm in 1954. This brief statement covers a career of unprecedented success in the brewery laboratories which may never be surpassed. His laboratory work, which was noted for its meticulous accuracy and attention to detail, ranged over a wide field and included expert glass blowing. He took a lively interest in the affairs of the Institute, including the Benevolent Fund, of which he was a keen supporter. He served as Chairman of the Dublin and District Section of the Institute from 1949 to 1952. In his earlier years he was an enthusiastic hockey and tennis player, and later a keen golfer and photographer, as well as a very successful gardener. 'His kindly nature and cheerful presence will be sadly missed by many.' (*A.* 1918, *F.* 1922; Council 1942–45) *D.* 1.7.61.

Henry Vincent Aird Briscoe. *B.* 24.9.1888. *Ed.* City of London School and Royal College of Science. A.R.C.S., D.I.C. In 1909 he became a research assistant to Sir Edward Thorpe at Imperial College, and was a lecturer there in 1911–17. From 1915 to 1921 he had varied experience as a consultant on chemical manufactures and fuel economy. In 1921 he was appointed professor of inorganic and physical chemistry at Armstrong College (now King's College), Newcastle, being also director of the department of chemistry from 1925. He was secretary of school examinations, University of Durham, as well, from 1925 to 1932. In 1928 he also became secretary and director of research to the Northern Coke Research Committee. During this period he continued working in a consulting capacity, being director of research to Walpamur Co. Ltd. In 1932 he moved to Imperial College as professor of inorganic chemistry and remained there for the rest of his career, being appointed director of laboratories for inorganic and physical chemistry in 1938. He retired in 1954.

During World Wars I and II he was engaged on highly confidential work for the government. He was an experienced and skilful driver and an expert photographer, being particularly interested in cine and micro photography. Some of his best scientific work was connected with precise physico-chemical measurements, including atomic weight and isotope-ratio determinations, and he published much of his research in papers communicated to the Chemical Society from 1912 onwards. He was an expert on dust sampling and the properties of industrial dusts in relation to occupational disease, for work on which he was awarded The Consolidated Gold Fields of South Africa Ltd gold medal (Institution of Mining and Metallurgy) in 1938.

Professor Briscoe kept up several activities after his retirement; he continued his work as an industrial consultant, as chairman of the editorial board preparing supplementary volumes to 'Mellor,' as treasurer of the Association of University Teachers, and as a special examiner for the Institute. He was an excellent judge of men and served on numerous selection boards. After World War II he gave much effort to improving the supply of trained technicians and directed the activities of various bodies working to this end.

Professor Briscoe served a number of societies, particularly the three chartered chemical bodies, in various honorary capacities. He was also a popular president of the Royal College of Science Association. Of his 16 years' service on the Council of the Institute and as chairman of its various committees, he spent 11 as a vice-president—a record that has never been equalled. (*F.* 1926; Council 1930–32, 36–39; Examiner 1932–36, Special Examiner 1943–61; Vice-President 1939–43, 46–49, 53–55, 57–59) *D.* 24.9.61.

Albert Coulthard. *B.* 25.6.1876. *Ed.* University of Manchester, 1895–98; University of Freiburg, 1908–10. B.Sc. (Manc.), Ph.D. (Freiburg). He started his career in 1898 as a science master at King Edward VI School, Chelmsford. Thereafter he became successively lecturer in chemistry, Christian Brothers College, Cork, 1900; senior science master, Clongowes Wood College, Co. Kildare, 1903; and lecturer in chemistry, Hackney Institute, London, 1910. He was in Germany at the outbreak of the First World War and was interned there until the Armistice. In 1919 he joined Levinsteins Ltd (now Imperial Chemical Industries Ltd, Dyestuffs Division) as a research chemist, and remained there until his retirement, when he was laboratory administrator and research chemist. He served as honorary secretary of the Manchester and District Section of the Institute for some 16 years. (*F.* 1920; Council 1930–33, 36–39, 40–43, 45–48) *D.* 15.7.61.

Edmond Hammond. *B.* 17.8.19. *Ed.* Holgate Grammar School, Barnsley; Mining and Technical College, Barnsley, 1937–41. B.Sc. (Lond.), Ph.D. (Sheff.). He became a laboratory steward at the Mining and Technical College, Barnsley, in 1937, a part-time lecturer in chemistry in 1941, and a full-time lecturer in 1943, reverting to part-time lecturing in 1947 on his appointment as a scientific officer in the British Coal Utilisation Research Association at the University of Sheffield. A few years later he took a post as technical manager at Lafarge Aluminous Cement Co. Ltd, a position which he held until the time of his death. (*A.* 1952) *D.* 4.7.61.

John Whitelaw Hills. *B.* 2.5.1880. *Ed.* Allan Glen's School, Glasgow; Anderson's College, Glasgow, 1894–97; Royal Technical College, Glasgow, 1896–98. He started his career as an assistant chemist at the Glengarnock Iron & Steel Co. Ltd. Thereafter he became successively assistant metallurgical chemist, Wm. Beardmore & Co. Ltd, Glasgow, 1899; general assistant to manager, Rhodesian Gold Mining Syndicate Ltd, 1902; official assayer of the mines department, Companhia de Moçambique, Portuguese East Africa, 1904; metallurgist, assayer and inspector of concessions, Companhia da Zambezia, Portuguese East Africa, 1906; engaged in prospecting privately in Salisbury, Southern Rhodesia, 1909; chief assayer, Abosso Gold Mining Co. Ltd, Gold Coast, 1910; chief of chemical and metallurgical laboratories, Zambesia Mining Development Ltd, Portuguese East Africa, 1912; chief assayer, Abosso Gold Mining Co. Ltd, Gold Coast, 1914. He returned to this country in 1915 and for a short time was engaged as an analytical chemist on the staff of F. W. Harris, Glasgow. Later the same year he became metallurgist to Naraguta (N) Tin Mines Ltd, Northern Nigeria. In 1922 he took a post as works chemist and manager to Hamilton Son & Co. Ltd, Glasgow. The following year he returned to his former post in Northern Nigeria, and in 1929 became metallurgical chemist and assayer to Associated Tin Mines of Nigeria Ltd, Lagos. In 1934 he joined Lupa Exploration Syndicate Ltd, Tanganyika and two years later became metallurgist to London Nigerian Tin Mines Ltd. In 1938 he took a similar post at Naraguta Tin Mines Ltd, Northern Nigeria. He returned to this country again in 1941 and took a post at the Royal Ordnance Factory, Chorley, becoming thereafter metallurgist, Federated Foundries Ltd, Falkirk, 1942, and assistant works manager, Electro-Platers Ltd, Glasgow, 1944. Later he was engaged as metallurgist with C. B. Nicholson (Scientific Instruments) Ltd, Glasgow. (*A.* 1921, *F.* 1929) *D.* 27.6.61.

Harold Alfred Thomas Mills. *B.* 8.11.06. *Ed.* University College, London, 1924–27. B.Sc. In 1928 he joined Imperial Chemical Industries Ltd as a research chemist, and remained with that firm for the rest of his life. At the time of his death he was education officer at the Alkali Division, Winnington. (*A.* 1928) *D.* 15.3.61.

George Eric Styan. *B.* 4.4.11. *Ed.* Bradford Technical College, 1933–41. B.Sc. (Lond.). In 1927 he became an assistant chemist at John Smith & Sons Ltd, Bradford, where he remained until 1949, when he was appointed senior assistant in dyeing and textile chemistry at Bradford Technical College (now Bradford Institute of Technology). He was promoted to senior lecturer in 1951 and to principal lecturer (dyeing) in 1959, a position which he held for the rest of his life. 'He was a most courteous, pleasant and conscientious colleague, always on the best terms with everyone, and always willing to give advice and service. . . . His hobby lay in horticulture and his enthusiasm on this matter was most infectious and appreciated by all his colleagues.' (*A.* 1941, *F.* 1960) *D.* 5.7.61.

Walter Arthur Voss. *B.* 6.10.1897. *Ed.* Brentwood Grammar School; City and Guilds of London Technical College, 1915–18. He joined the Gas Light & Coke Company (now the North Thames Gas Board) in 1918 as a chemist in the research laboratory at Beckton. In 1925 he was transferred to the Fulham laboratory

as an intelligence officer in charge of the library. Later he was transferred to Southend, where he remained for the rest of his life. For a time during the Second World War he was seconded to the Ministry of Fuel and Power. He was the author of papers in the scientific press. (*A.* 1919, *F.* 1943) *D.* 4.7.61.

John Kerfoot Wood. *B.* 22.5.1877. *Ed.* Central Higher Grade School, Manchester; Owens College (now the University), Manchester, 1893–97. D.Sc. In 1896 he became a science teacher at the Central Board School, Manchester, and Stalybridge Technical School. The following year he was appointed junior demonstrator in chemistry at the University College, Dundee, and teacher of practical chemistry at the Technical Institute, Dundee, becoming head of the chemistry department of the Technical Institute in 1902. He was promoted to assistant to the professor of chemistry at the University College in 1907 and to lecturer in chemistry in 1911. He left Dundee in 1919 on his appointment as lecturer in physical chemistry at Manchester College of Technology. He was promoted to senior lecturer in 1939, a post which he retained until his retirement in 1945. He acted as adviser to Indian students in the University of Manchester, 1922–43. During the First World War, in addition to his teaching duties, he was engaged in the preparation of drugs and worked for the Chemical Warfare Committee of the University College, Dundee. He was the author of a monograph on *The Chemistry of Dyeing* and of a number of scientific papers. (*F.* 1919) *D.* 1.7.61.

Charles Harcourt Wordsworth. *B.* 19.2.11. *Ed.* Bordon Grammar School, Sittingbourne; Sir John Cass Technical Institute, London, 1932–38. B.Sc. He became an assistant to E. M. Hawkins, of Canterbury, in 1931, and the following year, after a short term as assistant chemist at the Thames Milling Co. Ltd, Erith, joined the staff of J. Kear Colwell, independent consultant and public analyst for the Boroughs of Finsbury, Holborn and St Pancras, the County of Bedford and the Boroughs of Bedford and Luton. On the death of Mr Colwell in 1945, Harcourt Wordsworth took over the practice and the public analyst appointments, later adding the Borough of Paddington. In 1955 he acquired also the practice of Hawkins and Hawkins, of Canterbury. In early childhood he was a victim of polio, which left him with a withered right arm. In spite of his disability, he never refused help to anyone who approached him for aid or advice. (*A.* 1939, *F.* 1942) *D.* 1.6.61.

THE REGISTER

NEW FELLOWS

ARTHUR, Henry Richard, B.SC.(MELB.), M.SC.(W. AUST.)
(P) DALGLIESH, Charles Edward, M.A., PH.D., SC.D.(CANTAB.)
(P) HILL, Vernon James, B.SC.(WALES)
(P) MORGAN, Thomas Bryan, M.SC.(WALES), PH.D.(LOND.)

ASSOCIATES ELECTED TO THE FELLOWSHIP

(P) BALL, Clarence Patrick
(O) BARNES, George Reginald, M.SC.TECH.(MANC.)
(P) BELL, Ernest Arthur, B.SC.(DURH.), M.A., PH.D.(DUB.)
(O) BROWETT, Ernest Vernon, B.SC.(LOND.)
COURSEY, Donald Gilbert, B.SC.(LOND.)
(E) COX, Bertram Cecil, B.SC., PH.D.(LIV.)
(P) CURZON, Joseph David, B.SC.(LOND.), A.R.C.S.
(P) DEWHURST, John Reginald, B.SC., PH.D.(LOND.), A.K.C., M.I.GAS.E.
(P) DREY, Rudolf Eric Arnold, B.SC.(LOND.)
(A) GEDDES, John, B.SC.(ABERD.)
GELL, George Christopher Caesar, M.A.(CANTAB.)
(Q) GROWNEY, Gerard, M.SC.(LIV.)
(P) HERZKA, Alfred, B.SC.(LOND.)
(Q) HOLT, Geoffrey, M.SC.TECH., PH.D.(MANC.)
(P) HURST, Gerald Covington, B.SC.(LOND.)
(OG) HUSAIN, Intisar, M.SC.(ALIG.), PH.D.(MANC.)
(P) ISAACS, John, B.SC.(LOND.)
(OD) KAPUR, Narinder Singh, M.SC.(N.S.W.), PH.D.(B.H.U.), PH.D.(PANJ.), F.R.A.C.I.
(P) LATTER, Ralph William, B.SC.(LOND.), F.INST.PET.
(K) MCCONNELL, Alexander McDonald, A.I.M.
(R) MARSH, Dennis James, B.SC.(LOND.)
(P) MERCER, Donald, A.M.INST.S.P.
MORRIS, Allan Gordon Currie, B.SC.(LOND.)
(OE) MURTY, Kambhampaty Suryanarayana, B.ED., M.SC.(AND.)
PARISH, Denis Hedley, B.SC.(LEEDS), M.AGR.(BELF.)
(P) PETO, Andrew George, B.SC., PH.D.(LOND.), D.I.C.
(OG) RAMAIAH, Nanduri Atchuta, B.SC.(AND.), M.SC., PH.D.(B.H.U.)
(OF) RAO, Gudipaty Sreenivas, M.SC., PH.D.(SAUG.), PH.D.(CANTAB.), B.SC.(B.H.U.)
(S) REES, Richard Frederick, B.SC.(LOND.)
(OH) ROY, Durlav Krishna, B.SC.PHARM.(B.H.U.), D.SC., D.PHIL.(CALC.)
(P) RYDER, Charles, M.SC.(LEEDS), A.M.INST.F.
(B) SAVILLE, Rowland Whincup, B.SC., PH.D.(LEEDS)
(O) SMITH, Edgar Vernon
(O) STOKES, Frank Elliott
(P) TYLER, Joseph Francis Charles, B.SC., PH.D.(LOND.)
(P) WALLER, John George, B.SC., PH.D.(LOND.), A.R.C.S.
(SS) WILSON, Raymond Ernest, B.SC.(LOND.)
(A) WOODHAM, Anthony Arthur, B.SC., PH.D.(EDIN.)

NEW ASSOCIATES

(C) BADGER, Alan George, B.SC.(HULL)
(P) BEANLAND, Eric, M.SC.(LOND.)
BISHOP, Brian Cecil, B.SC.(BIRM.)
(P) BOYCE, George Edward, B.SC.(LOND.)
(H) BROOK, Peter Arthur, B.A.(CANTAB.), PH.D.(NOTT.)
(C) CATHERALL, Kenneth David, B.SC.(WALES)
(OJ) CHANMUGAM, Chandirapal, B.SC.(CEYL.)
CLINGMAN, Abraham Lionel, M.SC.(RAND), PH.D.(CAPE T.)
(P) CLOETE, Francis Louis Dirk, B.SC.(CAPE T.), M.SC.(NATAL)
(OF) DALVI, Vijay Jaywant, M.SC., PH.D.(BOM.)
(S) FLOATE, Michael John Seaborn, B.SC.(R'DG)
FLOWERS, Michael Colin, B.SC., PH.D.(S'TON)
(Y) FOSTER, Eric, B.SC.(LOND.)
(P) FULLER, Leslie Frederick
(P) GARSIDE, John Herbert, B.SC., PH.D.(LOND.)
GROENEWALD, Theo, B.SC.(RAND)
(Q) HEAL, Gerald Roger, B.SC.(LOND.)
(H) HEDDERICK, John Barclay, A.H.-W.C.
(P) JONES, Edmund George, B.SC.(DURH.), DIP.ED.
JUNEJA, Hari Ram, M.SC.(PANJ.)
(P) KNAPP, Trevor Frederick William Beresford, B.SC.(LOND.)
(Q) LAMB, Frank, B.SC., PH.D.(LOND.)
(S) LEYS, Thomas, B.SC.(ABERD.)
(Q) LOMAX, Geoffrey Radcliffe, B.SC.TECH.(MANC.)
MITCHELL, Robert Alexander, B.SC., PH.D.(BELF.)
(P) PARSONS, Roy, B.SC.(BIRM.)
PATIL, Vasant Sambhaji, B.SC.(POONA), M.SC., PH.D.(BOM.)
(P) PHILLIPS, Albert, B.SC.(BRIST.)
(E) PHILLIPS, Brian Desmond, B.SC.(WALES)
PONNAMPERUMA, Cyril Andrew, B.SC.(LOND).
(P) RAITT, James Gordon, B.A.(CANTAB.)
(P) REES, Trevor Colin, B.SC.(WALES)
(X) ROBERTSON, Charles Millar, A.R.C.S.T.
(A) RUSSELL, James, B.SC.(ABERD.)
SAFDAR, Muhammad, M.SC.(PANJ.)
(A) SCOTT, Norman Marshall
(P) SIMMONS, Paul, B.A., B.SC.(OXON.)
(G) TURNHAM, Donald Stuart, M.SC.(LOND.)

GRADUATE MEMBERS ELECTED TO THE ASSOCIATESHIP

(P) ANGUS, Henry John Flockhart, M.SC.(R'DG)
(P) ARROWSMITH, George Brian, B.SC.(LOND.)
(Q) BAILEY, Edward Brian
(H) BAINES, Charles Bryan, B.SC.(LOND.)
(C) BEAVON, Robert, A.C.T.(BIRM.)
(SS) BERRY, Christopher Thomas, A.R.T.C.S.
(H) BRAMLEY, John Michael
(M) BRATT, Ronald
(N) BROWNE, Anthony Arthur Briarly, B.SC.(LOND.)
(P) BROWNE, Timothy William Bailey, B.SC.(LOND.)
(H) BULLEY, Victor Stephen

(D) CAPP, Peter Donovan
(O) CLAGUE, Thomas Alan
(C) CLOW, John Michael, D.L.C.
(P) CONSTANTINE, Andrew, B.SC.(LOND.)
(A) CRAIG, James Boyle, A.H.-W.C.
(C) CROFTS, John, D.L.C.
(EE) EDGAR, Kenneth
(N) FAGAN, Ronald
(S) FAIRHURST, Ronald
(Q) FARMER, John Lea
(B) FINLAY, Annie Rowena, B.SC.(LOND.)
(P) GARDNER, Leslie
(P) GARFORTH, John David
(EE) GILLING, George
(D) GRIFFITHS, Gordon Hampton
(P) HAYMAN, David Frank
(Q) HEARN, Donald, A.R.T.C.S.
(P) HEATH, Barrie Edward
(FF) HEATLIE, James William Macrae, B.SC.(ST AND.)
(Q) HORROCKS, Geoffrey, A.R.T.C.S.
(S) JENKINSON, Stuart Clifton
(O) JONES, Terry Keith, M.SC.(WALES)
(D) JOYNER, Brian David
(P) KIPLING, Brian
(O) MCRAE, Donald Robert, D.L.C.
(C) MONCKTON, Sidney Robert
(S) MORRIS, Anthony
(E) MORRIS, Ivor Graham, B.SC.(WALES)
(P) MURPHY, John Michael
(P) PARSONS, Derek George
(O) PATTERSON, John Windram Seaton
(P) PENTON, Graham John, B.SC.(LOND.), A.R.C.S.
(Q) PERCIVAL, Sidney Joseph, A.M.C.T., A.R.T.C.S.
(C) PITT, Ernest Edgar Halford, B.SC.(BRIST.)
(FF) PRENTICE, Hugh Graham, A.R.C.S.T.
PURDIE, John Watson, B.SC.(GLAS.), PH.D.(BIRM.)
(Q) RILEY, Philip Neville Keith
(W) ROWE, David John, B.SC.(LOND.), A.M.I.GAS.E., A.M.INST.F.
(P) SEBELL, Patrick, B.SC.(LOND.)
(C) SMITH, Jack, A.C.T.(BIRM.)
(Q) SMITH, John, A.R.T.C.S.
(N) SQUIRE, Keith Harvey
(OB) TAYLOR, Colin James
(P) THOMAS, Thomas John
(N) TODD, John Francis James, B.SC.(LEEDS)
(E) TOMKINS, Wynn, B.SC.(LOND.)
(H) UFF, Barrie Cookson, B.SC.(BIRM.)
(P) WALL, David Thomas, A.C.T.(BIRM.)
(P) WARDEN, John Christopher, B.A., B.SC.(OXON.)
(J) WHITE, Hugh Briggs, A.H.-W.C.
(SS) WHITFORD, Derek
(Q) WOOD, Peter James
(C) YARWOOD, Eric Thomas, DIP.TECH., A.C.T.(BIRM.)
(N) YEADON, Alan, B.SC.(LEEDS)

NEW GRADUATE MEMBERS

(O) ABRAMSON, Solly Bernard
(K) ANDERSON, Alexander McLennan, A.H.-W.C.
(P) APSEY, Margaret Ena, B.SC.(LOND.)
(P) ASKEW, Marshall Wilfred, B.SC.(LOND.)
(L) ATKINSON, John Halstead, D.L.C.
(Q) BAINE, Peter
(C) BALL, Malcolm, D.L.C.
(J) BALNEAVES, John Strachan, A.H.-W.C.
(P) BATHIE, Frank Michael, B.SC.(LOND.)
(O) BEESLEY, James
(M) BENTLEY, Michael
(O) BOOTHBY, Leonard, B.SC.(DURH.)
(C) BOUCHER, Ernest Arthur, B.SC.(WALES)
BOWEN, James Harry, M.A.(CANTAB.), DIP.CHEM.ENG.
(D) BOWLER, David Charlton
(J) BOWMAN, William Stewart, A.H.-W.C.
(O) BOYLE, Ian Wilson
(Q) BREAKSPERE, Robert James
(P) BRIGNELL, Peter John, B.SC.(LOND.)
(K) BROWN, Allan Guildford, A.R.C.S.T.
(EE) BRUMFITT, Geoffrey, B.SC.(LEEDS)
(P) BURR, Robert George, M.SC.(LOND.)
(O) BUTLIN, Roy Norman
(Q) CALDWELL, David
(O) CAMPBELL, John Murray, D.L.C.
(O) CARRUTHERS, Peter William, D.L.C.
(Q) CARTER, Brian Howell
(D) CHAMBERLAIN, Brian Richard
(U) CLARKE, Alan Reginald
(O) CLIFFE, Francis Jeffrey
(O) CLUGAS, Alexander William
(M) COATES, Peter
(M) COCKERILL, Peter Edward
(O) COLCHESTER, John Edward, D.L.C.
(C) COLEMAN, James McCartin, D.L.C.
(O) COLLINS, Robert John
(Q) CONNOR, William Anthony
(D) COTTRELL, David Walter
(M) CROWE, Alan
(G) CROWE, Michael Louis, B.SC.(NOTT.)
(H) CRUDGINGTON, David Robert, D.L.C.
(O) DIXON, Michael Trevor
(J) DONALDSON, Elizabeth, A.H.-W.C.
(SS) ECCLES, John
(J) EDMOND, John Duncan, A.H.-W.C.
(Q) EDWARDS, William Howard
(SS) FENTON, Francis
(O) FERNLEY, Arnold Michael
(D) GERRISH, Barrie Crandon Beresford
(H) GILBERT, Andrew, D.L.C.
(P) GLADDING, Robert Neville, B.SC.(LOND.)
(C) GLOVER, Trevor John
(O) GOODALL, David Raymond
(M) GOWLAND, Michael Colin
(Q) GREEN, William
(M) GREENSIDES, Barry George
(O) GRUNDY, George Alan
(D) HALFYARD, Peter Raymond
(P) HALLIWELL, Allen, PH.D., B.SC.(LOND.)
(T) HAMMOND, Barbara Helen
(H) HANNA, Terence, D.L.C.
(O) HARDING, Frank, D.L.C.
(M) HAWKINS, Peter
(SS) HAWORTH, Malcolm Roger, D.L.C.
(J) HAY, James, A.H.-W.C.
(Y) HENRY, Norman, A.R.C.S.T.
(P) HENSON, Michael Geoffrey, D.L.C.
(O) HILL, Andrew William, B.SC.(LIV.)
(O) HOLDING, Michael Edward
(Q) HUBAND, Eric Reginald
(Q) HUGHES, Jeffrey
(Q) HUNTER, Geoffrey
(Q) JACKSON, Anthony
(Q) JONES, Barry David
(O) JONES, Neville Arthur
(C) KIGHTLEY, Raymond John, B.SC.(LOND.)
(WW) KILPATRICK, Thomas, A.H.-W.C.
(F) LAMBERT, Michael Balfour Thomas, B.SC.(N.U.I.)
(Q) LANSDALE, Brian Spencer
(Q) LEEMING, Peter Alfred
(Q) LEWIS, Cyril John
(M) LITTEN, John Atkinson
(C) LLOYD, John Brian Ford
(Q) LOWDEN, George Alan
(X) LOYNES, Alan, B.SC.(ST AND.)
(K) MACINNES, Norman Malcolm, B.SC.(GLAS.)
(J) MACKELLAR, Ian, A.H.-W.C.
(O) MALTPRESS, Alan John
(P) MARRS, Gordon James, DIP.TECH.(BIRM.)
(P) MAUNDER, Michael Joseph de Faubert, B.SC.(LOND.)
(O) MEARNS, Ronald David
MILLINGTON, James Peter
(D) MILLS, David
(J) MITCHELL, William Derek, A.H.-W.C.
(J) MORGAN, John Gore, A.H.-W.C.
(Q) MORRIS, Gordon Leonard
(WW) MORRISON, James Bryce, A.H.-W.C.
(P) MOSS, Leslie
(P) NEUFF, Alan Trevor, B.SC.(LOND.)
(P) PAGE, Donald Charles, B.SC.(HULL)

(J) PATERSON, John Chalmers, A.H.-W.C.
(SS) PATON, Gilbert Owen
(J) PHILP, John, A.H.-W.C.
(O) PLEWS, Ronald Wesley
(E) POPE, John Richard
(O) POSLETHWAITE, Brian
(E) PUGH, John Arthur, D.L.C.
(M) READHEAD, Michael John
(D) REED, Sydney George
(O) REGAN, George William
(O) RIDDOCH, John
(K) RODGER, William James, A.R.C.S.T.
(H) ROE, Charles Clifford, D.L.C.
(R) ROGERS, Adrian, B.SC.(LOND.)
(P) ROGERS, Brian, B.SC.(LOND.)
(D) SALTER, Brian George
(J) SANGSTER, Iain Strachan, A.H.-W.C.
(O) SHARP, Peter Frank, B.SC.(LIV.)
(SS) SHEPHERD, Malcolm David
(E) SKENE, Colin Lewis, B.SC.(WALES)
(P) SLOANE, Francis Clifford
(Q) SMITHIES, Barry
(P) SPEAKMAN, Derek Norman Alfred, DIP.TECH.(BIRM.)
(J) STARK, James Roger, A.H.-W.C.
(P) STEWART, Hector Norman McKenzie, A.H.-W.C.
(M) STOUT, Eric George
(C) SUNDERLAND, Philip, B.SC.(LEEDS)
(Q) SUTTON, Alan Hugh
(A) SUTTON, Anthony Hubert
(S) SYERS, John Keith, B.SC.(DURH.)
(O) SYKES, Bryan
(D) TALL, Peter David
(Q) TAYLOR, Edward Nicholas
(C) TIGHE, Brian John
(Q) TONGE, Kenneth Hodgson
(Q) TURNER, Leslie
(Q) WALLER, Brian Ernest
(O) WELSBY, Gerald
(O) WHITEHEAD, Norman
(J) WHYTE, John Nimmo Crosbie, A.H.-W.C.
(P) WILLIAMS, Colin James, B.SC.(LOND.)
(Q) WOLSTENHOLME, Walter Alan
(U) WOOD, Allen
(Q) WOODWARD, Antony Ian
(Q) WRIGHT, John
(K) WYLIE, John Angus, A.R.C.S.T.
(E) YARWOOD, Brian Charles, B.SC.(WALES)
(Q) YOUNG, Thomas

STUDENT ELECTED TO THE ASSOCIATESHIP

(P) OGIE, Peter John, B.SC.(LOND.)

DEATHS

Fellows

(P) ATHERTON, William, B.SC., M.SC.TECH., M.ED.(MANC.). Died 9 October, 1961, aged 63. *A.* 1922, *F.* 1939.

(D) EYNON, Lewis, B.SC.(LOND.). Died 18 October, 1961, aged 83. *A.* 1900, *F.* 1903.

(O) FRENCH, Alan, B.SC.(LOND.). Died 1 September, 1961, aged 51. *A.* 1937, *F.* 1960.

(H) HALL, George Fredrick, M.B.E., B.SC.(LOND.). Died 8 October, 1961, aged 63. *A.* 1923, *F.* 1935.

(C) LUNT, Walter Thomas, B.SC.(LOND.). Died 17 October, 1961, aged 66. *A.* 1935, *F.* 1945.

(C) WALKER, Alexander Nicholson, B.SC.(GLAS.). Died 25 September, 1961, aged 47. *A.* 1935, *F.* 1944.
WALKLEY, Allan, M.A.(CANTAB.), B.SC.(ADEL.), PH.D., D.SC.(LOND.). Died 10 August, 1961, aged 55. *A.*1934, *F.* 1946.
WRIGHT, Sidney Bristow. Died 1961, aged 88. *A.* 1893, *F.* 1897.

Associate

(R) LANFEAR, Eric William, B.SC.(LOND.). Died 17 October, 1961, aged 65. *A.* 1952.

Student Member

(D) LAMBERT, John. Died 22 September, 1961, aged 19.

LOCAL SECTIONS DIARY

Sections are glad to welcome members of other Sections to their meetings and social functions, except when numbers are restricted, as for works visits. Those wishing to attend meetings outside their own area are advised to write to the Hon. Secretary of the Section concerned, as the Institute cannot accept responsibility for any alterations or cancellations. All times are p.m. except where otherwise stated. For key to Local Sections *see J.*, 286.

(A) **Aberdeen.** 8 Dec. 8. Inorganic Heterocycles. Dr N. L. Paddock. Marischal College. Joint, C.S. and S.C.I.
—— 29 Dec. 3. Christmas Lecture. Dr P. M. B. Walker. Chemistry Department, Old Aberdeen. Joint, C.S. and S.C.I.

(P) **Battersea.** 30 Nov. 7. Chemical Aspects of the Work of the Warren Spring Laboratory. Dr C. C. Hall. Battersea College of Technology, Battersea Park Road, S.W.11. Joint, College Chem. Soc.

(X) **Billingham.** 23 Nov. Business Organization in the U.S.S.R. Y. Safrochuck. Staff Canteen, I.C.I. Ltd

(O) **Birkenhead.** 14 Dec. 7. Ladies' Evening: The Work of the Consumers' Association Ltd. Mrs H. W. Barber. Technical College

(C) **Birmingham.** 5 Dec. 6.30. Flameproofing of Textiles. Dr J. R. W. Perfect. College of Technology, Gosta Green. Joint, S.C.I.

(P) **Cambridge.** 5 Dec. 7.45. Aspects of Brewing. Dr J. Todd. Technological Research Station, Spiller's Ltd, Station Road
—— 14 Dec. 7.30. Social Film Evening. Technological Research Station, Spillers Ltd

(E) **Cardiff.** 8 Dec. 7. Analytical Research. Dr J. Haslam. University College. Joint, S.A.C. and S.C.I.

(P) **Chelmsford.** 8 Dec. 7. Explosives. Lt-Col B. D. Shaw. Mid-Essex Technical College and School of Art, Market Road. Joint, East Anglia Section

(P) **Dartford.** 20 Nov. 7.30. Some Aspects of the Chemotherapy of Cancer. Dr J. A. Stock. North-West Kent College of Technology, Miskin Road. Joint, Dartford and District Branch, Pharmaceutical Soc.

(F) **Dublin.** 13 Dec. 7.45. Some Structural Aspects of Co-Ordination Chemistry. Dr Mary Truter. Trinity College

(FF) **Dundee.** 20 Dec. 3. Christmas Lecture for Senior Pupils: Vitamins. Dr M. A. Pyke. Queen's College

(J) **Edinburgh.** 14 Dec. 7.30. Burgundian Wines of France, 1961. Prof. F. Mackenzie. Heriot-Watt College, Chamber Street. Joint, C.S. and S.C.I.

(W) **Exeter.** 13 Dec. 3. Christmas Science Lecture: Explosives. Washington Singer Laboratories. Joint, S.C.I.

(R) **Fawley.** 6 Dec. 5.30. Some Aspects of Psychology in Industry. S. J. Dalziel. Joint, Inst.Pet. and Inst. of Personnel Management

(K) **Glasgow.** 7 Dec. 6.30 for 7. The Ramsay Dinner. Central Hotel
—— 8 Dec. 7.15. The Structure of Natural Products by Direct X-Ray Analysis. Prof. J. M. Robertson. Royal College of Science and Technology. Joint, C.S., S.A.C. and S.C.I.

(L) **Huddersfield.** 27 Nov. 7.30. Annual Ladies' Night. Value for Money. The Hon. Mrs Kathleen Howie, Consumers Association Ltd. Whiteley's Restaurant, Westgate.

(M) **Hull.** 22 Nov. 7.30. Quality Control in the Pharmaceutical Industry. Dr G. E. Foster. Queen's Hotel. Joint, Pharm. Soc.
—— 4 Dec. 7.15. The Alkali Fusion of Fatty Acids. Prof. B. C. L. Weedon. Royal Station Hotel. Joint, O.C.C.A. and S.C.I.

(H) **Leicester.** 12 Dec. 7.30. Radio-Carbon Dating. H. Barker. College of Technology. Joint, College Chem. Soc.

(O) **Liverpool.** 25 Nov. 7. New Reactions, New Polymers. Prof. R. N. Haszeldine. Donnan Laboratories, Vine Street.

(P) **London.** 29 Nov. 6.30. Annual General Meeting. Shell Mex House, Strand, W.C.2
—— 7 Dec. 7. Ultra-Violet Spectroscopy. Dr T. M. Dunn. Northampton College of Advanced Technology, St John's Street, E.C.1

(P) **Maidstone.** 5 Dec. 7.30. Forensic Science. Dr I. G. Holden. Royal Star Hotel. Joint, Medway Branch, Pharmaceutical Soc.

(Q) **Manchester.** 1 Dec. 2. The Design and Construction of Laboratories. R. R. Young and P. J. Harrington. Manchester Literary and Philosophical Society. Joint, S.A.C.

(X) **Middlesbrough.** 28 Nov. 8. C.S. Lecture: Means to Some Ends. Prof. C. L. Wilson. Constantine Technical College.

(S) **Newcastle.** 29 Nov. 6.30. *d*-Orbitals in Chemical Bonds. Prof. D. P. Craig. Rutherford College of Technology
—— 15 Dec. Annual Dinner Dance. County Hotel. Joint, C.S. and S.C.I.

(W) **Plymouth.** 12 Dec. 3. Christmas Science Lecture: Explosives. Technical College. Joint, S.C.I.

(R) **Poole.** 28 Nov. 7.30. Ceramics. Dr N. F. Astbury. Poole Generating Station. Joint, Poole and District Technical Group

(R) **Portsmouth.** 1 Dec. 7. Forensic Science. Dr I. G. Holden. College of Technology. Joint, Portsmouth and District Chem. Soc.

(SS) **Preston.** 13 Dec. 7.30. Natural and Synthetic Antibiotics. Dr F. A. Robinson. Harris College, Corporation Street

(Y) **Reading.** 8 Dec. 7.30. Talk and Discussion: The Pattern of Higher Education. A. L. C. Bullock. Zoology Lecture Theatre, The University

(U) **Rotherham.** 6 Dec. 7. Radio-Carbon Dating. H. Barker. College of Technology

(R) **Salisbury.** 20 Nov. 7.45. Scientific Journalism. A. W. Haslett. Red Lion Hotel

(EE) **Seascale.** 24 Nov. 8. Ladies' Evening: Fashion and the Atomic Scientist. N. T. Sekers. Windscale Club

(U) **Sheffield.** 14 Dec. 7.30. The Anatomy of the Chemist. Dr T. S. Stevens. College of Technology, Pond Street

(R) **Southampton.** 4 Dec. 7.45. Social Evening (Film Show and Sherry Party). The University

(X) **Stockton.** 5 Dec. Dinner Dance. Spark's Café

(EE) **Whitehaven.** 1 Dec. Schools Lecture: Modern Applications of Radioisotopes. R. A. Faires. Technical College, Flatt Walks

(O) **Widnes.** 30 Nov. Application of High Resolution Nuclear Magnetic Resonance in Organic Chemistry. Dr J. K. Becconsall. College of Further Education

(T) **Wrexham.** 24 Nov. 7.30. Oxygen—Gaseous and Liquid. Its Production and Growth. J. B. Smith. Denbighshire Technical College. Joint, S.C.I.